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All Roads Lead to the Fair: How a 2022 Los Angeles World's Fair Would Accelerate the Implementation of Sustainable and Innovative Forms of Transportation

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**ALL ROADS LEAD TO THE FAIR:
HOW A 2022 LOS ANGELES WORLD'S FAIR WOULD ACCELERATE THE
IMPLEMENTATION OF SUSTAINABLE AND INNOVATIVE FORMS OF
TRANSPORTATION**

by

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**SUBMITTED TO SCRIPPS COLLEGE IN PARTIAL FULFILLMENT OF THE
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ABSTRACT

This thesis explores the potential impact of a World's Fair on urban mobility in Los Angeles County by 2022. A brief historical account of World's Fairs, and their impact on technological innovations in transportation will be given in conjunction with the development of transportation in Los Angeles. These accounts will help to contextualize an analysis of current plans to provide Los Angeles with transportation solutions, in light of the oversaturated automobile landscape in place today. Specifically, my research has revealed that the further development of light-speed rail systems paired alongside a mass adoption of autonomous vehicles would both alleviate contemporary transportation issues across Los Angeles County and accommodate the audience of international spectators that future mega-events may attract. Particular attention is paid to the Los Angeles World's Fair for its ability to galvanize the resources and support that these transportation innovations require. I therefore conclude that the Los Angeles World Fair should direct its focus principally in support of these aforementioned technologies, as opposed to other less feasible transportations solutions such as the Hyperloop.

INTRODUCTION

“The courage to think is the courage to imagine.” These were the words of Los Angeles Mayor Eric Garcetti at the plenary celebration for the Greenbuild Conference in Los Angeles, California, on October 2016. Garcetti’s words are quite fitting; as the city’s legendary Hollywood sign makes plainly visible, Los Angeles has no shortage of courage and imagination. Following the mayor’s speech was Lieutenant Governor to the State of California, Gavin Newsom. Newsom described the golden state as one of “dreamers and doers.” It is in this spirit that Angelenos have dreamt and envisioned the future City of Angels, one with light-speed rail systems, autonomous cars, and a “new high-speed ground transport system” commonly referred to as the Hyperloop (“Hyperloop”). Though critics may argue these futuristic technologies belong in a science-fiction film, they are in fact currently embedded in the proposed 2022 Los Angeles World's Fair. Planners hope to unveil Los Angeles as "The Connected City" by showcasing new possibilities for urban mobility moving forward (“About Us”).

The Los Angeles World’s Fair, known as the LAWF, is a vision led by architects, engineers, urban planners, and venture capitalists to develop a decentralized international exposition stretching across 88 cities in Los Angeles County over a period of two years, from 2022 to 2024. I have had the privilege of working as Co-Lead of the Sustainability Flex Team for the LAWF over the past two years. The LAWF’s burgeoning plan would connect cities, cultures, and ideas “via transit-oriented structural innovation” (“Frequently Asked Questions”). Bringing people, places, and possibilities together with a “new multi-billion-dollar transit system,” the LAWF aims to celebrate “cultural diversity, technological innovation, and human accomplishment” (“Frequently Asked Questions”). Though Hollywood has become

internationally renowned for its ability to transport viewers through visual images across a screen into unimaginable new worlds, the city at large must now demonstrate how it will provide its citizens with sustainable forms of mobility over the next few decades.

To create this well connected version of Los Angeles, the LAWF will build upon the tradition of previous World's Fairs. World Expositions, as they are known according to the Bureau International des Expositions, (BIE) are periodic celebrations typically showcasing the latest advances in arts, culture, and technology (De Groote). Founded in 1928, the BIE is the official organizing body that sanctions and recognizes World Expos. The BIE is responsible for choosing host cities, where "large, six-month Expos are organized every five years with one smaller, three-month version held in-between" ("World's Fairs"). There are currently four different variations of these exhibitions, including "World Expos, International Specialized Expos, Horticultural Exhibitions and the Triennale di Milano. Each in its own field aims at educating the public, sharing innovation, promoting progress and allowing dialogue and shared experience" ("The Expos"). Capturing the imagination of millions of visitors, World's Fairs enthrall, question, and redefine what is possible for urban society through daring innovation and engineering marvels.

History professor and World's Fair expert, Robert Rydell, in his 1984 book, *All the World's A Fair*, analyzes the origin of the term 'fair' derived from the Latin *feria*, meaning 'holy day.' "America's World's Fairs resembled religious celebrations in their emphasis on symbols and ritualistic behavior." These fairs "ritualistically affirmed fairgoers' faith in American institutions and social organizations, evoked a community of shared experience, and formulated responses to questions about the ultimate destiny of mankind" (Rydell 3). Rydell views these

international expositions as celebrations of “progress and technological advancement.” He believes expos showcase “the nation’s economic strength and artistic resources, highlighting new architectural forms and offering models for urban planning” (Rydell 2). The LAWF accordingly aims to advance this rich history of urban development with “a grand scale transition from a car-dependent culture to the widespread adoption of mass transit.” This would in large part be achieved both through the enhancement of Los Angeles’s public transportation system and through the implementation of technologically advanced forms of mobility, including light-speed rail, autonomous vehicles, and a Hyperloop system (“About Us”).

These visions for a connected Los Angeles are far from the reality most Angelenos face in 2016. The City of Angels may be heralded for a lot of different reasons (e.g., Hollywood glamour, luxurious beaches, diverse cultures, multifaceted architecture, diverse landscapes;), however, one thing it has been notoriously and unapologetically known for is its horrific traffic and the health-compromising air pollution it creates. Ask anyone who has ever been on the 405 freeway during rush hour traffic what mobility looks like in Los Angeles and you will hear the most horrifying but accurate account of beeping horns in standstill traffic beside idling SUV’s, with no end in sight. The animosity which results from the neverending highway traffic is all too real for Angelenos, permeating into the walls of office buildings as colleagues calculate who suffered the longest commute. Traffic is featured in Los Angeles’s media and pop culture as well. An article featured on *Timeout Los Angeles*, titled “67 Things You’ll Never Hear an Angeleno Say,” showcases Angelenos distaste for traffic. The second phrase featured is, “I’d love to give you a ride to LAX [Los Angeles International Airport], and the third, “I’m gonna take a little joyride up the 405 around 5pm tonight. Clear my head.” The many lost hours wasted

behind a steering wheel can become even comical at times. Saturday Night Live performed a skit called *The Californians* that poked fun at how Angelenos use freeways as primary geographical reference points (Masters). In one skit, a character named Stewart says “get back on San Vicente, take it to the 10, then switch over to the 405 North, and then it will dump you out on Mulholland where you belong!” Naturally, Stewart’s wife responds, “Stewart! At this time of day? It will be jammed! Are you crazy?” (“The Californians: Stewart Has Cancer”). There is also a classical radio station in Los Angeles named KUSC, which devotes its 5pm time slot to playing “anti-road rage” melodies (“Classical KUSC on Twitter”). While comical, the dire traffic conditions severely impact the countless drivers coming in and out of Los Angeles on any given day. It is therefore necessary to make monumental transportation upgrades to correct a city all too often stuck in a state of gridlock.

The LAWF’s aim to provide Los Angeles with the transportation solutions it so desperately requires dovetails perfectly with the historical legacies of past World’s Fairs. These international expositions are vessels of creative design that have ushered forth the iconic Eiffel Tower in 1887, the wondrous Ferris Wheel in 1893, the first television broadcast in 1939, touchscreen technology in 1982, and countless more innovations in design, architecture, and technology (Green). Consider, for example, “the superhighway system that transformed the United States less than 20 years later” which was showcased at the New York World’s Fair in 1939 (Waldmeir). This particular exhibit helped popularize the automobile, which has now become deeply ingrained in the cultural fabric of Los Angeles.

The automobile has a rich history in Los Angeles; what was once monumental in the regions’ formation, now impedes its very growth. Cars play an integral role in Los Angeles’s

“collective memory” (Pastor). As Italian architect and designer Aldo Rossi claims in *The Architecture of the City*, (1982) automobiles are the “guiding thread of the entire complex urban structure” (130). While necessary for navigating the freeway-encrusted landscape of Los Angeles, the perceived value of the automobile has drastically changed over time. Long gone are the days where automobiles embodied “the vital and brilliant realization of a thousand-year-old dream of humanity,” as the 20th century world renowned modern architect Charles-Édouard Jeanneret Gris, known as Le Corbusier once proclaimed. Once a symbol of freedom associated with Jack Kerouac and the Beat Generation of the 1950s, the car is now for many a far cry from the mechanism by which passengers reach their “next crazy venture beneath the skies” (Kerouac 92). Los Angeles’s growth has eclipsed what Frank Lloyd Wright had envisioned in his utopian community, Broadacre City, where “the automobile would reign supreme [in a] truly prophetic vision of modern America” (Novak). A more accurate depiction of the automobile’s role in Los Angeles in 2016 comes from Jane Jacobs, who is one of the prominent voices that has spoken out against the role of automobiles in urban settings. Jacobs is considered the Grandmother of contemporary urban planning and is most well known for her book, *The Death and Life of Great American Cities* (1961). In another one of her texts, *Dark Age Ahead*, she states, “not TV nor illegal drugs but the automobile has been the chief destroyer of American communities” (Jacobs 37). These negative effects have been felt across the Los Angeles region, as the reliance of the automobile has resulted in myriad health and environmental concerns for Angelenos. Automobility is thus a major concern for future mega-events in Los Angeles, as its traffic congestion and pollution will only be exacerbated by the millions of attendees that such events attract. Los Angeles is in need of sustainable transportation, which according to the 1987

Brundtland report on sustainable development, is defined as “transport that meets the current transportation needs without compromising the ability of future generation to meet these needs (Black). It is for this reason that the LAWF has embraced innovative technology, like autonomous vehicles, to correct the failings of Los Angeles’s current transportation infrastructure and simultaneously increase future mobility.

The LAWF has also identified mass transit via rail as a means to increase mobility through the county. This is especially interesting given Los Angeles’s history; in 1924, the city relied primarily on rail transit. These original train lines “helped shape the region and its buildings” (Hawthorne). Even renowned architectural historian, critic, and admirer of the automobile, Reyner Banham, mentioned in his book, *Los Angeles: The Architecture of Four Ecologies*, how “the automobile and the architecture alike [of Los Angeles] are the products of the Pacific Electric Railroad.” Rail transportation thus remains inherent to the Los Angeles landscape, making its revival essential.

Though the BIE is currently made up of 169 member countries, the United States is not one of them, having left the organization in 2001. Therefore, if Los Angeles were to host a World’s Fair, technically it would be an unofficial exposition neither recognized by the BIE nor able to receive funding from the the United States government (“The USA Needs the BIE. The BIE Deserves the USA”). The privately funded LAWF was set up as a California Flexible Purpose Corporation. This allows the LAWF to generate funds, sell shares, and simultaneously focus on “social entrepreneurship through organizations that want to make money and do good” (“Frequently Asked Questions”).

Additionally, the LAWF recognizes that America hasn't hosted a World's Fair in over thirty years. In fact, the last official American World's Fair was held in New Orleans in 1984. Furthermore, the LAWF is not the only group currently seeking to orchestrate a World's Fair in the US. One such example is the Bay Area Council, a business group located in Northern California. According to John Grubb, the Bay Area Council's chief of staff, the fair of 1984 "was the ghost that has haunted the world-expo experience of the United States ever since" (Landphair). Due partly to the "sparse crowds [that] drove the 1984 New Orleans World's Fair into bankruptcy" and partly to "isolationist-minded Senator Jesse Helms of North Carolina" who controlled the Senate Appropriations Committee, Congress was influenced by the United States Department under the Reagan Administration to drop out of the BIE shortly thereafter (Michaels). This was in large part seen as an effort to reduce "foreign entanglements" and reduce spending at the time, after the failure of the 1984 World's Fair. This has not only alienated Americans from the magnificent feats of cultural progress and technological innovation which these events produce, but also from the international audience of citizens who attend them regularly (Landphair).

Despite these aforementioned obstacles, the LAWF nevertheless holds great promise towards achieving increased connectivity in Los Angeles by the year 2022, both with regard to international culture and local mobility. This thesis will argue that the LAWF has the potential to implement sustainable and innovative forms of transportation. As a result, it will also serve as an impetus to reduce Angelenos' dependency on emission producing vehicles. I will begin by analyzing past World's Fairs from the 19th to the 20th century; particularly, how they showcased transportation innovation and have consistently paved the way for future forms of mobility. I will

then move my focus from World's Fairs to Los Angeles and the city's own transportation history. This portion of my thesis will present a historical account of Los Angeles' initial rail system, how the city became dependent on the automobile, and the recent push to enlarge the rail network in use today. Next, I will discuss the LAWF's plans to connect Los Angeles through groundbreaking transportation infrastructure. Though these plans currently feature Hyperloop technology, my research will suggest that the LAWF instead focus its resources towards the further expansion of rail transit and a mass adoption of autonomous vehicles.

The LAWF is one of many efforts that have risen in response to the failing highway system in Los Angeles today. Though certainly not without its challenges, I believe that a World's Fair may galvanize the necessary support to realize the vision put forth by this organization come 2022.

CHAPTER 1: World's Fairs and their Legacies

World's Fairs have the power to “deeply influence the content of many individual and collective beliefs and values,” (Rydell 3) as their reach extends beyond host countries through millions of international attendees. They are global events with four distinct goals: to educate the public, celebrate progress, promote innovation, and foster cooperation.

These international exhibitions serve as a “dialogue platform for progress and cooperation” for the international community (“What Is an Expo”). Participating countries are given the opportunity to display items of their choosing in a pavilion of their own. Guest countries typically participate in organized conferences, workshops, debates, and meetings that often inspire increased cooperation and diplomacy. For the general public, these international exhibitions are an “educating and entertaining experience” with many different activities, displays, and shows available. With “interactive exhibitions, groundbreaking technologies,” and cultural displays, these educational events double as spectacles, capturing the imagination of its millions of visitors while redefining the impossible (“What Is an Expo”). Then, for the host country, World's Fairs serve as a “tool for nation branding and development” (“What Is an Expo”). Due to the fact that World's Fairs also invite world leaders, decision makers, and millions of participants, these events can “strengthen [the country's] international image and position itself as a key player in the international arena” (“What Is an Expo”). In the same vein, World's Fairs claim to boost economic and urban development. As a result, the BIE claims that both local and national development will increase after these fairs take place in terms of housing capacity, job creation, economic investment, global business, and transportation networks. Lastly, World's Fairs allow “international outreach and economic opportunities” for the

everyone involved (“What Is an Expo”). Participants are given a unique opportunity to “present their achievements, cultures, and products” to invited countries, “international organizations, the civil society and companies” (“What Is an Expo”). Both individual members and groups are exposed to new networks of people on one of the most renowned international stages.

While the methods in which World’s Fairs achieve these goals has changed over time, since the first International Exhibition in 1851, they still offer countries all over the world opportunities to “flaunt their wealth and sophistication by displaying inventions, art and architecture (Michaels). World’s Fairs have struck a “responsive chord in the lives of many Americans,” (Rydell 3) attracting “tens of millions of people to their architectural, industrial, agricultural, and anthropological exhibits” (Rydell 135) in years past. While traditionally serving as centers for trade, entertainment, and education, these large-scale events, known as mega-events, are primarily short-term occurrences that both positively and negatively affect their host cities (Roche). The development of these host cities are inextricably linked to the happenings at World’s Fairs. Furthermore, the BIE claims to effectively re-use previous expo sites increasing the economic, social, and cultural needs of the area, while also providing spaces to be repurposed, as civic centers or museums, for example (“What Is an Expo”). According to World Exposition historian, Urso Chappell, “an expo marks a certain ‘coming of age’ for a city. It can aid a city’s physical redevelopment as well as the nation’s image abroad” (Kantchev). These fairs often dramatically propel the urban planning of their surrounding communities into the future, though doing so may also leave the city in debt as it works to finance the millions of dollars required for its construction (Mullin). Secretary General of the BIE, Vicente Gonzalez Loscertales, echoes Chappell’s point, claiming how “for the hosts, expos are a key part of a

strategic plan for urban development and act as catalysts for accelerating infrastructural transformations” (Kantchev). One of the fundamental ways through which World’s Fairs leave their mark on host cities, and the world at large, is the production of transportation innovations that set new precedents for urban mobility.

London’s 1851 Great Exhibition

The first historical World’s Fair took place in London in 1851, known as “The Great Exhibition of the Works of Industry of All Nations.” The event rose in response to “the demand for creating new economic links between nations in face of the triumph of the free trade policy” (“London”). This first fair was attributed to the efforts of Prince Albert, the husband of Queen Victoria, and Henry Cole, an art patron and civil servant. This fair was principally located in Hyde Park, under the direction of architect Joseph Paxton. The site came to be known as the Crystal Palace; due to its industrial design, this main building was considered an architectural marvel (“London”). Sadly, it burned down in 1936 (De Aenlle). Paxton’s design used “combinations of prefabricated cast iron, laminated wood, and standard sized glass sheets” (Merin). This fair was strongly influenced by the “industrial revolution and the colonial ambition of the time,” and built off the growing momentum driving material progress based on technological innovation (“A Short History of Expos”). The Great Exhibition therefore also encapsulated notions of progress and science, a point echoed by the Queen of England herself, as “every conceivable invention” could be found there (Auerbach 29). Furthering the Queen’s amazement, Charles Dickens remarked, “I’m not saying there’s nothing to see, but that there’s too much to see” (“A Short History of Expos”).

The Crystal Palace held exhibits organized in the following four categories: raw materials, machinery, manufacturers, and fine arts (“Crystal Palace: A History”). One of the most noteworthy exhibitions was that of machinery, featuring the locomotive engine. In this display, “visitors could discover the railroad equipment from the UK and Germany [and] steam engines” which were uncommon in Europe at the time (“A Short History of Expos”). For the onlooker, there was “every kind of steam engine, including the giant railway locomotives” (“The Great Exhibition”). These locomotives were the ultimate symbol for progressive society at the time, both figuratively and literally transporting its citizens into the future.

At this time, railroads were referred to as Iron Horses’ as they brought “potent new technology, promising (and ultimately delivering) a substantial increase in the productivity of transportation” in the modern age (Huenemann). According to Angus Sinclair, author of *Development of the Locomotive Engine*, the “steam engine represents the most successful invention ever brought into use for converting the potential energy of coal or other fuels into mechanical work.” Considered to be cutting edge technology in the 19th century, the steam engine had “no parallel in the records of human achievements since the world began” (Sinclair 1). This machinery display also featured the Crampton Locomotive Engine (“Royal Collection”), notable for its “slope backed firebox” that provided the locomotive engine with larger and higher driving wheels. With a lower center of gravity, this technology allowed the engine to safely travel at higher speeds for the first time (White 451). The Great Exhibition’s impressive display of transportation innovation and technological progression set precedence for future World’s Fairs to come.

The grand success of this first international exhibition encouraged and inspired other cities to launch their own World Fairs. This created a movement of international exhibitions which displayed technological innovation, often emphasizing transportation infrastructure. These international exhibitions were thoroughly complex events that served myriad functions including that of “architectural laboratories, anthropological field research stations, proto-theme parks, engines of consumerism, exercises in nationalism, and sites for constructing seemingly utopian and imperial dream cities of tomorrow” (Rydell 136).

Chicago’s 1893 World’s Columbian Exposition

The United States hosted its own World Fair a mere 42 years after the Great Exhibition. This fair, named The Columbian Exposition, played “a crucial role in the cultural reconstruction” of America after the ending of the Civil War in 1865 (Rydell 135). From 1876 to 1916, a network of World’s Fairs were put on display, shaping “the worldview of millions of Americans” (Rydell 235). Visions of social progress were likewise largely influenced by America’s Industrialization Movement taking place during the same time period. As Alan Trachtenberg illustrates in his book, *The Incorporation of America: Culture and Society in the Gilded Age* (1982), 19th century American expansion brought “labor unrest, newly powerful cities, and newly mechanized industries, the ideals and ideas by which Americans lives were reshaped, and American society became more structured, with an entrenched middle class and a powerful business elite.” Threatened by class conflict, World’s Fairs provided upper-class prominent elites with the opportunity to project their “vision of progress as racial dominance and economic growth” on a global stage (Rydell 8).

Furthermore, the 1893 World's Columbian Exposition took place a few years after Chicago's Great Fire of 1871. It was held from May to October 1893 in Jackson Park, Chicago, with participation from fifty other countries ("World's Columbian Exposition"). According to Judith A. Adams, in her article titled *The Promotion of New Technology Through Fun and Spectacle: Electricity at the World's Columbian Exposition*:

The World's Columbian Exposition of 1893, a celebration of the 400th anniversary of Columbus's journey to the New World, was a germinal influence in American culture and industrial progress. Chicago's "White City," as the Exposition was popularly dubbed, was a plaster actualization of a prophetic New Jerusalem, a perfect world, created from America's technological ingenuity, engineering prowess, capitalist enterprise, frontier spirit, and the relentless, all-encompassing planning of its designers. Montgomery Schuyler, the noted architectural critic, summed up the profound cultural influence of the Exposition as its successful integration of "unity, magnitude, and illusion." The White City achieved, for a fleeting summer, a grand actualization of the dream of America's Puritan colonists to establish a "new Heaven," a "City on a Hill" in the New World wilderness (Adams 45).

With this vision of progress in mind, the first American World's Fair also led the way for industrial innovation and displayed various forms of transportation that were the in an exhibit of its own, aptly titled the Transportation Building. Designed by Louis Sullivan, leader of the Chicago School, the Transportation Building was considered one of the fair's most interesting expositions ("World's Columbian Exposition"). The building itself had an "elaborately decorated golden arch" surrounding the main entrance and an interior representing a Roman basilica ("Columbian Exposition - Transportation Building").

Aside from the building's extraordinary exterior [and interior] decoration, the Transportation Building was reminiscent of an enormous train shed both inside and out. The train shed was a relatively new form of architecture, and was a particularly apt form for a fair building that celebrated means of transportation (Jeffcote).

With the train-shed exterior, the building also served as the entrance to the fair for trains coming from all throughout the nation, literally showcasing transportation progress both as display and in action.

The Transportation Building's hallway was divided into three different sections, each devoted to "railway, marine, and vehicle" transportation ("Columbian Exposition - Transportation Building"). This exhibition showcased "every vehicle known to man, ranging from a baby carriage to a rail dining car" (Bolotin and Laing 94). As described in the book *The World's Columbian Exposition: The Chicago World's Fair of 1893*, this building included:

row after row of displays showed models of every type of nautical craft, a Roman galley, a Chinese junk, Fulton's first engine, African bullock carts, Aboriginal canoes, Chinese sedan chairs, Japanese rickshaws, Indian howdahs, Arabian camels and even pneumatic cash carriers" (Bolotin and Laing 96).

Found within the Transportation Building were displays of bicycles, historical wagons, railroad relics, locomotives, steamships, and an exhibition on "strange and unusual" transportation. Items within these exhibition included a tandem bicycle, a forty-pound roaster, a 150 year-old wagon, the Job Bull railroad steam locomotive train, over two hundred models of steamships, an ancient chariot from the Etruscan museum based in Florence, as well as a "sled of spruce with runners made from the jawbone of a whale from Unalakleet," a small coastal city in Northern Alaska (Bolotin and Laing 97). Found within the railway section of the Transportation Building was The Baltimore & Ohio Railway Company's "Railways of The World" exhibit ("Columbian Exposition-Transportation Building"). On display therewithin was the John Bull Steam locomotive, used from 1831 to 1866, which was among some of the first engines to be imported from Britain to America (White 7). The John Bull Locomotive was also a major influencer

providing American inventors with the framework to produce their own domestic locomotives.

Another cutting-edge engine on display was John Ramsbottom's "Lady of the Lake" class locomotive (Sinclair 37).

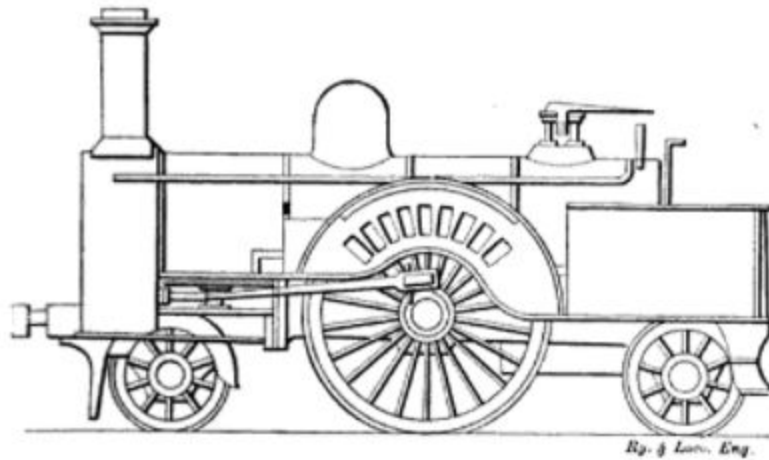


Fig. 20. Ramsbottom's Lady of the Lake

Figure. 1. Lady of the Lake Locomotive. Sinclair, Angus. *Development of the Locomotive Engine: A History of the Growth of the Locomotive from Its Most Elementary Form, Showing the Gradual Steps Made Toward the Developed Engine, with Biographical Sketches of the Eminent Engineers and Inventors who Nursed it on Its Way to the Perfected Form of To-day. Many Particulars are Also Given Concerning Railroad Development.* A Sinclair Publishing Company), 1907.

Sinclair heralds this engine as one that “attained great popularity and had fertile a progeny” (37).

Considered well designed for the time period, “the engine had cylinders of 16x24 inches, driving wheels 90 inches diameter, 1,068 square feet of heating surface, and 15 square feet of grate area” (Sinclair 37).

The locomotive engines on display at this World's Fair celebrated the development of the Transcontinental Railroad. The first Transcontinental Railroad, built from 1863 to 1869, connected Omaha, Nebraska and Sacramento, California with approximately 2,000 miles of track, thus uniting the country from East to the West for the first time in history (Ambrose). Considered as one of the “greatest achievements of the American people in the nineteenth

century,” the first Transcontinental Railroad “accomplished the dream that America had of convenient and efficient transport and travel across the country” (“Transcontinental Railroad”). The building of this railroad allowed Americans to transport both themselves and goods from “coast to coast in a matter of days” at far lower prices than before” (“Transcontinental Railroad”). The reduction in cost led to a significant expansion of America’s economy. The transcontinental line “knitted together America in a way that no comparably large country had been knitted together before and it paved the way for the industrial revolution in America to spread from the East to the West to make the United States the global economic power it eventually became” (“Transcontinental Railroad”). Visions of American progress propelled the railroad system forward and was therefore central to the World’s Fair of 1893.

While visions of progress were being manifested through rail technology, the country was sheathed in an air of unsettlement due to increasing mechanization and social reform movements (Rydell 4). Consequently, the American public was searching for order. In a time where national identity was waning, World’s Fairs provided the perfect solution to bolster pride and collective progress. This was echoed in President William McKinley’s speech at the 1901 Buffalo World’s Fair which called attention to how international exhibitions “record the world’s advancement...stimulate the energy, enterprise, and intellect of the people and quicken human genius. Every exposition has helped this onward step” (Rydell 4). President McKinley and the organizers of these World’s Fairs equated societal progress with America’s economic expansion. However as Rydell asserts, progress in its true form is not “necessarily inherent in change or development or growth,” but a positive attribute linked to some sort of change (Rydell 4). Organizers of the expositions simply saw these fairs as mechanisms for continued economic

growth, placing America and its economy at the top of the world, as a means to create a utopian future, built upon the “subordination of nonwhite people” (Rydell 4). Seen as the answer to America’s problems, World’s Fairs were seen as innovative solutions to America’s problems and were used to reassert America’s power and dominance.

The display of modernity, civilized progress, and technological advancement at World’s Fairs emphasized a deep racial divide in America between countries that were industrialized and those that were not. While these international exhibitions were meant to represent advancements and innovation for all of its global participants, the American fairs often compared their industrial advancement against that of other nations, creating a divisive narrative that Stuart Hall wrote about in his classic essay the “West and the Rest” (1966). With the railroad acting as America’s figure of modernity, other less westernized and less industrialized countries were considered primitive, ingraining a deep sense of racism in these fairs. Rather than championing various cultures and their ideas, these international displays instead informed other countries of America’s superiority, given their “moral, cultural, and intellectual qualities,” (Rydell 5). This explicitly materialized the principle of ‘Manifest Destiny,’ which refers to the belief developed in 1840 that “it was Anglo-Saxon Americans’ providential mission to expand their civilization and institutions across the breadth of North America” (“Manifest Destiny”). Existing on such a public scale, World’s Fairs disseminated this belief to the wider public who attended these events. It thereby directly led to “a partial but crucial explanation for the interpretation and popularization of race and progress” during this time period. This great responsibility was often abused, as “World Fairs existed as part of a broader universe of white supremacist

entertainments,” (Rydell 6) discrediting societies and people that were not as technologically advanced as Americans.

While the United States was thriving on the newfound industrial momentum that led to western lands via railroad, it swept nonwhite people under the tracks through the repression, colonization, and degradation of Asians, Africans, Afro-Americans, Native Americans, and American Hispanics. World’s Fairs provided “Americans a powerful and highly visible, modern, evolutionary justification for long-standing racial and cultural prejudices.” (Rydell 6) This severely restricted immigration, and shaped both foreign and domestic policy. World’s Fairs achieved this by popularizing and diffusing representations of ethnic minorities as live entertainment, locating them just feet away from other fair concessions, such as wild animal enclosures and joyrides. Examples of these deeply racist exhibits were placed through a series of colonial villages, first established at the 1889 Paris Exhibition and featured in Chicago with “living ethnological displays of Native Americans and other nonwhite people” (Rydell 7). While these racist acts were straightforward cases of exotification, exploiting humans as objects for amusement for a mostly white population, organizers and consultants from the Smithsonian Institution viewed this work as “popular education that is too important to be neglected” (Rydell 7). The elitist organizers responsible for these embellished representations and reconstructed displays of minority culture aimed to “mute class divisions among whites, providing them with a sense of shared national purpose,” all the while pushing their white supremacist agenda. It was this hyper-fanaticized notion of primitivism that America was trying to distance itself from, and claimed itself as superior to, as it embraced locomotives and pursued industrialized progress.

“The influence of America’s international expositions permeated the nation’s arts, political, system, and economic structure” leaving an “enduring vision of an empire” (Rydell 7). While America’s vision of progress boosted the nation’s western ideals, it also demonized marginalized groups who had not embraced similar western notions of industrialization.

Paris’s 1900 Exposition Universelle

The next exhibition to significantly progress the state of transportation was the 1900 Exposition Universelle in Paris, France. While previous World’s Fairs had been highly influenced by industrialization, the 1900 Exposition Universelle was different; it was instead characterized by its “artistic approach and its promotion of Art Nouveau” (“Paris 1900”). Perhaps as a peaceful response to an otherwise troubling political climate France faced under the Third Republic, which lasted from 1870 to 1940, this exposition remains “in the collective imagination” as the symbol of Paris’s Belle Epoque” (“1900 Paris”). The Belle Epoque was a “period of economic growth, insouciance, amusement and faith in progress” for France. While a showcase of the 19th century at the “dawn of a new era”, it also looked to the future and searched for modernity. This desire can be seen through the significant use of electricity” that powered the event (“1900 Paris”). The aim of this international exhibition was to “amaze and dazzle the visitor” (“1900 Paris”). The 1900 Exposition was considered an extremely successful event, it hosted 40 different countries with 51 million visitors from March to December, 1900. It had attracted 10 million more guests than Paris’ population at the time, due to its “funfair” characteristics and attractions, such as the iconic Ferris Wheel (“1900 Paris”).

The remnants of this fair are seen in many of the transportation systems still used today. Hector Guimard's Art Nouveau metro entrances were designed to celebrate the inauguration of the city's "first metro line between Porte de Vincennes and Porte Maillot ("1900 Paris") showcased at the exhibition. This metro line certainly increased mobility for the millions of fairgoers that came to Paris for the exposition. Fast forward to the present in 2016, the Paris Metro is considered one of the world's best metro systems by CNN Travel and "is in the top-five for busiest city-rail services in the world" (Falzon).

The Exposition Universelle also debuted the diesel engine (Jensen). Making large strides for alternative forms of transportation for years to come, the "first public demonstration of vegetable oil based diesel fuel was at the 1900 World's Fair, when the French government commissioned the Otto company to build a diesel engine to run on peanut oil" (History of Biodiesel Fuel). Rudolph Diesel originally invented the diesel engine in the 1890's which developed out of a desire to

improve upon inefficient, cumbersome and sometimes dangerous steam engines of the late 1800s. The diesel engine works on the principle of compression ignition, in which fuel is injected into the engine's cylinder after air has been compressed to a high pressure and temperature. As the fuel enters the cylinder it self-ignites and burns rapidly, forcing the piston back down and converting the chemical energy in the fuel into mechanical energy. Dr. Rudolph Diesel, for which the engine is named, holds the first patent for the compression ignition engine, issued in 1893. Diesel became known worldwide for his innovative engine which could use a variety of fuels (History of Biodiesel Fuel).

Both Rudolph Diesel and the French government played an important role in the preliminary experiments using vegetable oils as a form of fuel to "power early diesel engines for agriculture in remote areas of the world, where petroleum was not available at the time" ("History of Biodiesel Fuel").

The French government was interested in vegetable oils as a domestic fuel for their African colonies. Rudolph Diesel later did extensive work on vegetable oil fuels and became a leading proponent of such a concept, believing that farmers could benefit from providing their own fuel. However, it would take almost a century before such an idea became a widespread reality. Shortly after Dr. Diesel's death in 1913 petroleum became widely available in a variety of forms, including the class of fuel we know today as "diesel fuel." Modern biodiesel fuel, which is made by converting vegetable oils into compounds called fatty acid methyl esters, has its roots in research conducted in the 1930s in Belgium, but today's biodiesel industry was not established in Europe until the late 1980s. With petroleum being available and cheap, the diesel engine design was changed to match the properties of petroleum diesel fuel. The result was an engine which was fuel efficient and very powerful. For the next 80 years diesel engines would become the industry standard where power, economy and reliability are required ("History of Biodiesel Fuel").

Unfortunately, the diesel fuel originally developed by Diesel earned "little attention in times of high oil prices and shortages" ("History of Biodiesel Fuel"). This was coupled with the fact that vegetable oil had a higher viscosity than most diesel engines could handle at the time in comparison to petroleum diesel fuel. However, more than a thousand years later, biodiesel has become increasingly relevant and "one of the fastest growing alternative fuels in the world," due to its "clean emissions profile [and] ease of use" ("History of Biodiesel Fuel").

The 1900 Exhibition Universelle had many long lasting impacts, specifically on transportation, both in the 1900's and beyond. Emerging as a response to Art Nouveau, highly popularized at the exhibition, came Art Deco characterizing the 1920s. "Known for blending modern decorative arts with industrial design" Art Deco became synonymous with luxury, extravagance, and glamour, especially evident with automobiles. "The automobile, a rapidly evolving mechanical child of the 20th century, thus became the perfect metal canvas upon which to express the popular art deco style" ("Rolling Sculpture: Art Deco Cars from the 1930s and '40s"). The Art Deco vehicles later inspired French Car Company, Citroen, to design what was

considered the “culmination of futuristic innovation, along with limitless artistic expression” (“25 Stunning Art Deco Cars”).

Chicago’s 1933 Century of Progress Exhibition

Chicago hosted its second World Fair in 1933, “in honor of the 400th anniversary of the discovery of the American continent by Christopher Columbus.” This World’s Fair, known as the “Century of Progress,” welcomed more than 27 million visitors (“1933 Chicago”). In an attempt to undo the tarnished image resulting from an increasingly dangerous mafia presence in the late 1920’s, “organizers chose an impressive site of over 170 [hectares] in Burnham Park along Lake Michigan and selected a theme that would enable them to show off their prestige and power” (“1933 Chicago”). The 1933 Chicago World’s Fair was quite a success, as it made a profit and reopened in 1934. However, it wasn’t accomplished without difficulty as the interest in World’s Fairs had temporarily waned after World War 1 with “electronically mediated forms of entertainment” (Rydell 47). In fact, there had been a fourteen-year hiatus of World’s Fairs from the 1915 San Francisco World’s Fair to Barcelona’s in 1929 (“Expo Timeline”). Nevertheless, it was in an effort for countries to boost public interest in themselves and some of their colonial enterprises that World’s Fairs continued once again circa 1930 (“Expo Timeline”). After the unstable economy of the 1920s and 1930s, the “United States government with support from major corporations reignited the American exposition tradition with a series of spectacular Depression-era fairs” (Rydell 47).

Much like previous World’s Fairs, transportation innovation was also featured prominently at the “Century of Progress” exhibition. This World’s Fair was home to the largest

aerospace exhibition that had ever existed. Transportation became the greatest attraction of the event, featuring “The Sky Ride: a 191 meter-high (628 feet) cable car system that offered visitors a panoramic view of the site. At night, a light show would illuminate the attraction and transform the cable car cabins in rockets” (“1933 Chicago”).

Transportation infrastructure at the Chicago World’s Fair of 1933 increased mobility amongst fairgoers and fundamentally shaped the city’s transportation infrastructure for years to come. It quickly became apparent that transportation needed improvement” to accommodate the “48,469,227 fair visitors back and forth to the lakefront site” (Sadowski). Chicago Surface Lines, operator of the street railway system of Chicago from 1913 to 1947, played an important role in expanding public transportation for the Fair, “as two streetcar line extensions were hurriedly undertaken” (Sadowski). These streetcars brought passengers to the fairgrounds and connected passengers to the greater Chicago area. “The two line extensions, from Roosevelt and Cermak, were retained for about 20 years” (Sadowski). As seen from the image below, Streetcars were the quintessential image representing the “Century of Progress,” illustrating the importance that transportation infrastructure had for this World’s Fair.



Figure 2. Sadowski, David. Chicago World's Fair Poster. "The Chicago World's Fair, by Streetcar." *The Trolley Dodger*. N.p., 6 Feb. 2015. Web. 30 Nov. 2016.

New York's 1939-1940 World's Fair

The next World's Fair to showcase transportation systems was the 1939-1940 New York World's Fair's and its introduction of superhighways. Despite the fact that this World's Fair began on the 150th anniversary of the "government of George Washington and the new American constitution," this fair was "resolutely turned towards the future" and encompassed the theme "The World of Tomorrow" ("1939 New York"). It praised "the world of capitalism, consumerism, and democracy" ("1939 New York"). Taking place in Queens at the park now known as Flushing Meadows-Corona Park, the World's Fair opened on April and continued on through October 1939. While the fair attracted over 25 million visitors in 1939, the fair experienced significant financial hardship and was forced to re-open in 1940 to continue paying off costs. It then ran from May to October of 1940. The continuation of the fair was further

complicated by the fact that 1940 marked the second year of World War II in Europe. This meant that many visiting countries could no longer participate in the second opening. This resulted in the participation of five fewer countries, meaning “several pavilions, such as those of Poland and the Czech Republic, did not reopen” (“1939 New York”). Irrespective of these financial and international complications, this World’s Fair’s first opening in 1939 still managed to effectively showcase scientific progress. “There’s always that moment where you enter the gates, lots of people, lots of crowds, music, food, and you really are entering another world” (Swartout). The 1939 and 1940 New York World’s Fair “introduced you to the entire world, not just culturally but also in terms of science and technology, of art and design” (Swartout).

The fair transported its visitors into the future and reimagined the possibilities for mobility in the “Futurama” exhibit. This exhibit, a part of the Transportation zone sponsored by General Motors (“1939 New York”), took visitors on a ride over “a sprawling diorama imagining the America of 1960 with automated cars cruising down multi-level highways” (Michaels).



Figure 3. Futurama Exhibit at 1939 New York World’s Fair. General Motors. “Futurama: Highways & Horizons.” 1939.

Seen above, this exhibit was designed by industrial designer Norman Bel Geddes, a major proponent for superhighways. Geddes stated “a free flowing movement of people and goods across our nation is a requirement of modern living and prosperity” (Fotsch). This futuristic exhibit with multi-lane superhighways that crossed the country was one of the most popular exhibits at the World’s Fair (Fotsch). Seen in the figure below, fairgoers were able to peer into the future landscape of the United States).



Figure 4. Futurama Exhibit at the 1939-1940 New York World’s Fair featuring Superhighways
General Motors. “Futurama: Highways & Horizons.” 1939.

As illustrated in John Fotsch’s article, *The Building of a Superhighway Future at the New York World’s Fair*:

The exhibit, like the fair as a whole, emphasized hope for the future at a time when daily life for many contained fear and uncertainty. The United States had endured a decade of

depression; war had erupted in Europe where fascism and communism were expanding, and the instability of the economy seemed to fuel the growth of radical movements in the United States. These fears and hopes were epitomized by President Roosevelt's opening address to the fair: "the eyes of the United States are fixed on the future. Our wagon is hitched to a star. But it is a star of good will, a star of progress for mankind, a star of greater happiness and less hardship, a star of international good will, and above all, a star of peace. May the months to come carry us forward in the rays of that hope." It was expected that new technology would help to bring on this better future, and the progress of technology was embodied in the rapid progression of cars in the Futurama. The exhibit sped time past contemporary crises just as it increased the traveling speed of the automobile to 100 miles per hour. Stated differently, the problems of the "modern world" were linked to the problem of traffic congestion, so superhighways, by creating "a free flowing movement of people and goods," could resolve the nation's problems and bring "prosperity" (Fotsch 65).

This exhibition at the World's Fair "continued a series of transportation innovations that began with the rise of the trolley and automobile at the turn of the century" and put forth a new vision of urbanism in America (Fotsch 67). The Futurama exhibit had a large influence on the Interstate Highway Act of 1956, as it popularized "the concept of the superhighway and built the foundation for the eventual construction of the largest public works project in history" (Fotsch 67). Fitting for the fair's theme of the future, this Futurama display has left a long lasting impact on the American landscape, altering the planning and development of future cities.

The Futurama exhibit left both positive and negative effects on contemporary forms of transportation. Superhighways had increased mobility, allowing passengers quicker access to their destinations without entering into city centers. They also helped define the modern American city, built upon principles of freedom and democracy, which greatly contrasted the similar transportation infrastructure used in Germany and Italy under fascist regimes for defense and popular control. Nevertheless, superhighways left a mark, still visible today, in cities like Los Angeles where automobility reigns supreme.

Seattle's 1962 Century 21 Exhibition

The next fair to leave a lasting impact on futuristic forms of mobility was the Seattle World's Fair that ran from April to October 1962. This World's Fair, also known as the Century 21 Exhibition, displayed what the world would might look like in the year 2000 and beyond (The Impact of the Cold War on Washington) aimed at emphasizing transportation innovation. Drawing over 10 million visitors, the fair was divided into five areas, including: "the World of Science, the World of the 21st Century, the World of Commerce and Industry, [and] the World of Art and Entertainment" ("1962 Seattle"). "Aimed at emphasizing the contributions of science and research to the American Way of Life" ("1962 Seattle"), the fair presented the opportunity to show the "nation's scientific prowess to the world" ("Century 21 World's Fair"). This World's Fair took place during the Cold War and reflected the nation's political sentiment of at the time acting as "the nation's response to communism" (Berger). As of a result of the intense geopolitical climate, many Communist states did not participate in the fair. "The Soviet Union declined to participate, and the People's Republic of China, North Vietnam, and North Korea were not invited" ("Century 21 World's Fair").

The fair also aimed to "help reduce the shock of the Soviets' successful space program" ("1962 Seattle"). Seen as a response to the Soviet's launching of Sputnik, the world's first artificial satellite, the fair strived to display America's own advances in science and space technology. With this context in mind, one of Seattle's most visible remnants from the Century 21 Exhibit is the Space Needle, that many consider "analogous with Seattle itself" (De Aenlle). The Space needle became as synonymous as Paris was with the Eiffel Tower, also an architectural displayed at a World Exhibition in 1887 ("The Impact of the Cold War on

Washington”). The needle was “a conduit for Seattle’s aspirations to be a modern city of art, technology, architecture and refined fare” (Berger). Given the Space Race context of the fair, “space travel was the key of the Century 21 Exposition” (“1962 Seattle”).

Conceived and built by private interests, the Space Needle adhered to the themes of science and space in virtually all details. High speed elevators, designed to resemble "space capsules with large vision ports," carried guests up to the observation deck and a revolving restaurant that was said to resemble a flying saucer and was lighted at night so as to seem to be hovering in the sky. Dining hostesses wore "skin-tight gold coveralls" meant to resemble space suits. And the color scheme of the building exterior was, literally, out of this world: "astronaut white, galaxy gold, re-entry red and orbital olive." The Space Needle summarized the orientations of Century 21 (“The Impact of the Cold War on Washington”).

Building off the themes of futuristic endeavors in science and space, the US government gave approximately \$9 million to the fair, chiefly to build the NASA-themed United States Science Exhibit, which later became Seattle’s Pacific Science Center. Featured at this exhibit was astronaut John Glenn's Mercury space capsule, the *Friendship 7*, “which was the first manned American spacecraft to orbit the earth” (“The Impact of the Cold War on Washington”).

Space travel was not the only form of mobility featured at the 1962 World’s Fair however; there was also a General Motors exhibit featuring the future of the automobile, seen below.

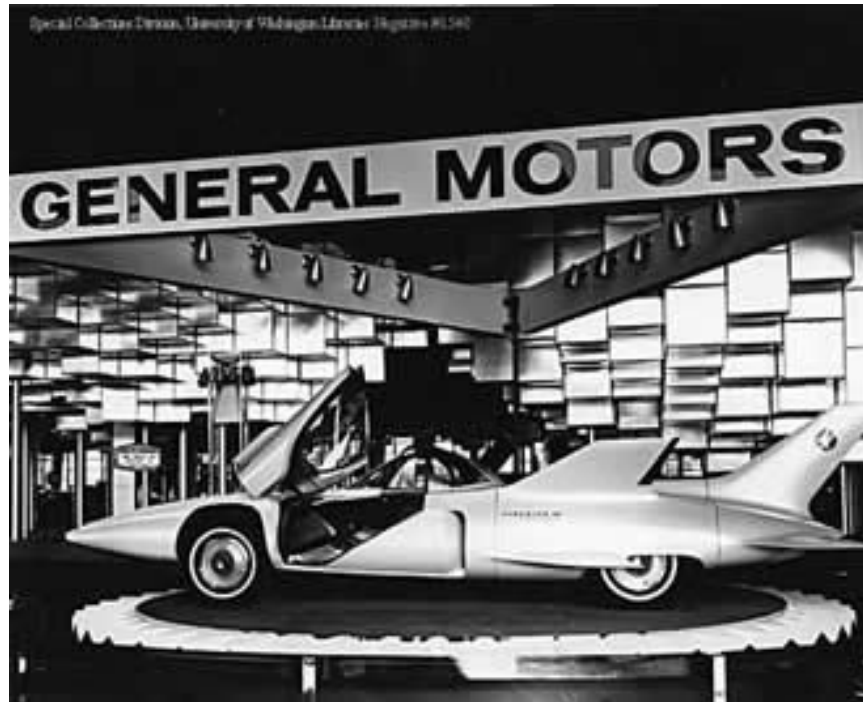


Figure 5. General Motors Automobile Display at the 1962 Seattle World's Fair. "The Impact of the Cold War on Washington, The 1962 Seattle World's Fair." *Center for the Study of the Pacific Northwest, University of Washington*. N.p., n.d. Web. 30 Nov. 2016.

"The space-age motif which guided design everywhere at Century 21 led to the suggestions that the cars of tomorrow, including the General Motors *Firebird III* would be shaped like rockets. What mattered most in 1962 was how fast and how stylishly one traveled--not how much fuel was consumed or how much pollution was produced" (Findlay 247).

In addition to the space and automobile technologies on display, the 1962 World's Fair aimed to commemorate air travel, as Seattle was home to the Boeing Airplane Company. According to John M. Findlay in an article for *Pacific Northwest Quarterly*, "The Off-center Seattle Center: Downtown Seattle and the 1962 World's Fair," this was "the primary source of postwar growth that Seattleites wished to celebrate with a fair." This fair provided Seattle with the opportunity to further expand its economy by building "a more diversified industrial

economy that would reduce the region's heavy reliance on defense spending by the Federal Government" (Findlay 4).

Building off of the theme of space travel and transportation, the city of Seattle leveraged the opportunity to explore innovative forms of urban transit, especially with the fair being a short distance away from the city's central business district:

Almost all American world's fairs have featured futuristic transportation, and Century 21, with its emphasis on jet travel, rocket cars, and space exploration, was no exception. The high-speed commuter train called the monorail, however, which was built to link the city center to the fairgrounds, amounted to more than a demonstration of modern technology or a prediction of some vague tomorrow. Planners' vision of a compact, busy downtown called for a system of public transportation that would begin to replace autos within the city center and compete against cars for commuters from outlying areas.

Keeping in line with the theme of the future, the Century 21 Exhibition helped lead the way for sustainable transportation, with the creation of a monorail.

Modern monorails are based on a single solid beam that supports and guides the train; the carriages are either suspended beneath the track, or sit on top, with their wheels straddling electricity, which is carried on a 'third rail' either within, or connected to, the main beam. Conductive shoes on the carriages then transmit the current to the train (Harfield).

The Seattle monorail, constructed by the European Company, Alweg Rapid Transit Systems, was the "nation's first full-scale commercial monorail system" ("Seattle Center Monorail"). It provided "a crucial link between fairgrounds and the amenities" between downtown Seattle and the Seattle Center ("About the Monorail"). "The trains carried more than eight million guests during the six months of the fair, easily paying for the cost of construction," which was estimated at \$3.5 million ("About the Monorail"). Having switched ownership from the city to Seattle Monorail Services in 1994, the monorail is still considered a popular form of rail transportation in 2016. The monorail transports "approximately 2 million passengers every

year” (“About the Monorail”). It is also a celebrated icon for the city and has become “an important fixture in Seattle for locals, who use the trains during major festivals and sporting events” (“About the Monorail”).

The same monorail was constructed at the Disneyland Park in Southern California in 1959, a few years before the Seattle exhibition. Walt Disney had discovered Alweg during his travels in Germany (“Disneyland Monorail”). The monorail came to Los Angeles when America’s interest in automobiles was on the rise, hoping to make it the modernist city.

While the use of the monorail may have been employed from America’s need to compete with the Soviets in the realm of technology, it is interesting that Seattle planners chose rail transportation as the technology of the future. This is especially thought provoking considering that the Futurama exhibit at the 1939 New York World’s Fair, less than thirty years earlier, had showcased superhighways as projected forms of mobility for the 1960’s. Planners of the 1962 Seattle World’s Fair did not envision superhighways, but instead viewed the monorail

as a ‘futuristic solution’ to the prospect of downtown traffic congestion and served as evidence of ‘sound, progressive city planning’ to meet the widely perceived need for rapid transit... like urban renewal, the monorail experiment contributed to a picture of a vital, cohesive, enlarged downtown” (Findlay 5).

The Century 21 Exhibit provided planners in Seattle the opportunity to alter the design of the American landscape with regards to transportation planning. These “‘electronic highways’ ferried passengers and goods back and forth with a minimum of delay, noise, and exhaust” (Findlay 7). The monorail acted as the beginning of rapid transit for the city of Seattle, a highly futuristic, effective, and sustainable form of mobility for the time period. Public transit has since grown in Seattle with the implementation of its own streetcars, light rail, the Pronto Cycle share

program, rental cars for the day and by the hour, in addition to buses and shuttles (“Getting To & Around Seattle”). Strides for improved mobility have therefore been made since the iconic Seattle monorail was first implemented, symbolizing state of the art innovations in public transportation since that of rail.

Hannover’s Expo 2000

Unlike previous World’s Fairs that focused on showcasing advances in science, technology, and transportation, the Expo 2000, held in Hannover, Germany focused more on presenting sustainable solutions for the future (“2000 Hannover”). Taking place from June to October 2000, the Hannover Expo hosted approximately 18 million visitors (“2000 Hannover”). Expo 2000 encompassing the theme of “Humanity, Nature, and Technology” and aimed to “directly address the difficult issue of imagining and encouraging a sustainable future” (McDonough and Braungart 3). “In order to insure that the design and construction related to the fair will represent sustainable development for the city, region, and world, the City of Hannover commissioned designer and author William McDonough and German chemist, Michael Braungart to create The Hannover Principles. McDonough and Braungart, most known for co-writing the foundational sustainability text, *Cradle to Cradle*, were contracted as sustainability thought leaders to inform the international design competitions for EXPO 2000” (McDonough and Braungart 3). The Hannover Principles, still considered relevant today are as follows:

1. Insist on rights of humanity and nature to co-exist in a healthy, supportive, diverse and sustainable condition.

2. Recognize interdependence. The elements of human design interact with and depend upon the natural world, with broad and diverse implications at every scale. Expand design considerations to recognizing even distant effects.
3. Respect relationships between spirit and matter. Consider all aspects of human settlement including community, dwelling, industry and trade in terms of existing and evolving connections between spiritual and material consciousness.
4. Accept responsibility for the consequences of design decisions upon human well-being, the viability of natural systems and their right to co-exist.
5. Create safe objects of long-term value. Do not burden future generations with requirements for maintenance or vigilant administration of potential danger due to the careless creation of products, processes or standards.
6. Eliminate the concept of waste. Evaluate and optimize the full life-cycle of products and processes, to approach the state of natural systems, in which there is no waste.
7. Rely on natural energy flows. Human designs should, like the living world, derive their creative forces from perpetual solar income. Incorporate this energy efficiently and safely for responsible use.
8. Understand the limitations of design. No human creation lasts forever and design does not solve all problems. Those who create and plan should practice humility in the face of nature. Treat nature as a model and mentor, not as an inconvenience to be evaded or controlled.
9. Seek constant improvement by the sharing of knowledge. Encourage direct and open communication between colleagues, patrons, manufacturers and users to link long term sustainable considerations with ethical responsibility, and re-establish the integral relationship between natural processes and human activity (McDonough and Braungart, 6).

McDonough and Braungart expanded upon the already existing definition of sustainability that came from the World Commission on Environment and Development. They state sustainability is: “meeting the needs of the present without compromising the ability of future generations to meet their own needs” by embracing all parts of nature to meet one's “own needs now and in the future” (McDonough and Braungart 4). The principles were left intentionally general so as to

integrate the concept of sustainability in the planning of Expo 2000 and future World's Fairs alike.

This World's Fair showcased the importance sustainability has in building design and construction. Sustainable design, as defined by McDonough and Braungart, is design that “requires awareness of the full short and long-term consequences of any transformation of the environment. Sustainable design is the conception and realization of environmentally sensitive and responsible expression as a part of the evolving matrix of nature” (McDonough and Braungart 4). An example of this was found at the Venezuelan pavilion that featured a zero-waste building made of reusable materials. The pavilion embodied tensegrity and biomimetic design; the building itself opened and closed like a flower. “The flower petals were positioned according to the weather, to shade, keep dry or allow sun to shine on the pavilion” (“2000 Hannover”). The pavilions at the Hannover Expo were a window into the future of sustainable building and spoke to Hannover's second principle on the interdependence between nature and design.

Hannover also showcased newly developed transportation infrastructure imbedded in the expo. Planners of this World's Fair constructed an entirely new railway station, “a new network of urban roads,” an extended tram network, and a newly constructed third terminal at the Hannover Airport (“2000 Hannover”). Expo 2000 emphasized the crucial role sustainability played in both design and transportation planning.

The aforementioned sustainability principles can also be seen as a model to critique past exhibitions that had not lived up to these new environmental standards. Focusing instead on emphasizing grandiose visions of progress and innovation, past World's Fairs did not have the

same pressures prioritizing sustainability. The Seattle World's Fair of 1962 is an example of that: "the Seattle World's Fair was predicated on the idea of mastering nature, even nature in the form of outer space. It celebrated such advances as synthetic fertilizers and virulent pesticides, faster cars and jet planes, without questioning their impact upon the world's ecosystems" ("The Impact of the Cold War on Washington"). These values have since changed, specifically in the 1960's with the emergence of Rachel Carson's book *Silent Spring* (1962). Carson's book spread awareness of the detrimental effects that toxic chemicals can have on the environment. While her book was released too late for planners of the Seattle World's Fair to consider, the World's Fair held in Spokane, Washington a dozen years later in 1974 focused on the theme of "*protecting-not* mastering the environment" ("The Impact of the Cold War on Washington"). Both the growing environmental movement of the 1960s and the contemporaneous momentum for sustainable design found at the Hannover World's Fair have impacted subsequent World's Fairs and their efforts to be more sustainable.

Onwards and Upwards

World's fairs have undoubtedly been shaped by the pressing issues facing society and have reciprocally magnified those social issues from the 19th century's industrialization movement and technological progress to the 20th century's Space Race and increased sustainability efforts. World's Fairs have also evolved contemporaneously with racial theory in America, moving away from 19th century notions of Manifest Destiny to a post-colonial 20th century. While their presence has undoubtedly left a mark through their countless architectural

wonders and groundbreaking innovations, critics question whether or not they still remain pertinent in the 21st century.

As Robert Rydell discusses in, *A Companion to Museum Studies*, “world fairs seem like ephemeral theme parks from another time” (Rydell 135). It is to many people’s surprise that these international exhibitions still exist today. “With the rise of television, jet travel and satellite communications, fairs’ magnetism as must-see windows on the future has waned. Theme parks and commercial spectacles such as auto shows, meanwhile, sapped expos’ ability to thrill. Fairs have scrambled for relevance by focusing on big ideas like energy and ecology” (Michaels). Most fair organizers attempting to bring back a World’s Fair in the US are met with apathy. Organizer Mark Fries, who is attempting to bring a World’s Fair to Las Vegas, “says the universal reaction to suggestion of a new expo is: “Wow, do they still have those?” (Michaels). While the idea of hosting a World’s Fair may seem unfamiliar to most Americans, as they have become “obscure cultural references,” those who remember what they once were will be even more unfamiliar with what they now represent (“Film”).

Even so, there has been an increase of interest from various groups to bring these exhibitions back to the United States. The 2013 award-winning documentary, *Where’s the Fair?* is indicative of the interest Americans have in reinstating these fairs:

It inspired a nation, and introduced the technological wonders that would transform the lives of generations of Americans. For more than a century, the World’s Fair was a fixture of American culture. It ushered in the industrial revolution and brought the most exotic corners of the world together in a peaceful celebration of how we are the same, and how we are different. It was an event with scale and grandeur unequalled in American history. And then it disappeared...or did it? *Where’s the Fair?* is the unraveling of a great American tragedy. It is the story of the loss of not only the world’s greatest celebration of culture, art, and science, but also of American exceptionalism, and perhaps even the American dream. However, *Where’s the Fair?* is not a history film. It is a raw, critical, contemporary exploration of the policy decisions that continue to isolate and disconnect the United States from the international community. It is the story of what happens when

a nation stops dreaming. It is the surprising answer that you find when you ask... *Where's the Fair?* ("Film").

While World's Fairs consistently aim to reach for the future across all industries, specifically that of transportation, their ideas are still tethered to the conception of the past and the limitations of the present. As cities across the United States campaign to host future World's Fairs or aim to rejoin the BIE, their themes must continue to encapsulate the future while growing from past failures. It is with this critical lens, that I will analyze the Los Angeles World's Fair and its plans for sustainable transportation.

CHAPTER 2: Los Angeles's Transportation History

"The best way to predict the future is to create it." -Abraham Lincoln

Lincoln's words are posted on the Los Angeles World's Fair website as a way to capture the spirit behind the planners' aim to present "the first ever Cityscape Fairground!" in Los Angeles by 2022 ("About Us"). World's Fairs are known to leave "shimmering memories on the minds of countless millions [with]...vast urban improvement and a stunning inventory of technical innovation" ("About Us"). As illustrated previously in Chapter 1, "this World's Fair is all about connectivity. Los Angeles County stretches across 88 cities, and for the first time ever, all of them will come together via transit-oriented structural innovation and unprecedented distribution of fairgrounds" ("Frequently Asked Questions"). LAWF was created in 2013 by a group of "high tech entrepreneurs, architects, engineers, and futurists" (Cundill, Henry et al) who envision "a future focused city all Angelenos can take pride in" ("About Us"). It was founded as [a] Flexible Purpose Corporation in August 2013 by a team that met leading railLA, a non-profit that promoted high-speed rail in California. Organizers sought to showcase the impact of an enlarged rail network on Los County and initially planned to host an exhibition to garner public interest. The original pitch for an international exhibition was limited to urban design and architecture. The World's Fair platform was consequently adopted to showcase the future of Los Angeles. Their shared passion for a new and improved Los Angeles thus became the inspiration for the founding of the LAWF (Schierbeek).

This World's Fair comes to Los Angeles at a crucial time, as it can bolster public support for alternative forms of transportation, specifically that of rail. According to the LAWF's website:

today our beautifully diverse neighborhoods are separated by a web of jammed freeways. If Los Angeles can connect all of our countless distinct communities – physically and emotionally on a global stage – then perhaps the world will see first-hand how it can be done. Los Angeles is ripe for this metamorphosis. LAWF® will be the catalyst and will provide a stage on which The Connected City™ can be introduced to the world (“About Us”).

Planning to have over “100 countries, 1,000 companies and 100 million visitors participating from around the world – LAWF® is going to be the biggest, World’s Fair EVER! At its core will be Los Angeles’s new multi-billion-dollar transit system which inspired the theme: The Connected City™” (“About Us”). “Since its formation, LAWF has raised in-kind contributions of more than \$1 million, generated awareness and more than \$50,000 in funding on Indiegogo. In addition to public backing, LAWF has garnered significant support from the LA County Board of Supervisors, as well as Los Angeles’ transportation department, METRO” (Cundill, Henry et al).

The need to expand Los Angeles’s rail transportation system is fundamental to the LAWF. In fact, the LAWF was born out of the belief that only through “new methods of urban design and civic planning can we cure the ills of our horrible traffic problem in Los Angeles” (“Frequently Asked Questions”). Jefferson Schierbeek is one of the founding members of the LAWF, currently serving as leader of the Design, Mapping, Planning, and Construction Flex Team. According to Schierbeek, the LAWF aims to cure the ills resulting from New York’s 1939 World’s Fair Futurama exhibit, which introduced automobiles and freeways. Futurama had influenced urban planning in cities for generations to come; specifically, a 1950’s post war New York, from which sprung renowned urban planner, Robert Moses’ freeway city. Schierbeek stated that society has “taken that brilliant 1939 idea as far as it could go and what has happened is that suburbs have started to decline, as they are not sustainable in terms of cost, energy, and

development with people that dispersed across the city” (Schierbeek). This dilemma inspired Schierbeek and other founding LAWF members to envision what the next hundred years would look like for Los Angeles’s, especially with regard to transportation. Schierbeek and his colleagues began thinking about how rail could represent a “beautiful nexus of connection” by uniting the city, its inhabitants, and the world (Schierbeek). They aspire to help Los Angeles become the new example for the United States and the world for transportation, encompassing these ideals of connectivity.

With the goal to utilize and further develop public rail transit in Los Angeles, the LAWF will take place across the Greater Los Angeles Area, emphasizing the idea of a connected city. Historically, world’s fairs have had one or two fairgrounds where pavilions are concentrated and most of the activity takes place. The Los Angeles World’s Fair™ will have multiple pods and pavilions dispersed throughout Los Angeles County along new transit infrastructure (“Frequently Asked Questions”).

The LAWF’s theme of “connectivity” works hand in hand with their desire to have a “dispersed” fairground accessible through an enlarged network of rail transit. LAWF planners expect that their efforts further develop rail infrastructure will “encourage new legislation that will actually change how people get around the city” (“Frequently Asked Questions”). The LAWF aims to solve the “nation’s worst traffic problem” belonging to the traditionally decentralized modern city that is Los Angeles (“Frequently Asked Questions”).

The scheduling of Los Angeles’s proposal for hosting the LAWF is also timely as “Los Angeles is facing a revolution. The Los Angeles World’s Fair is poised to be the nexus that brings our state and local government, large corporations, and citizens of all walks of life together to make Los Angeles the city of the future.” The LAWF plans on utilizing Los Angeles’s growing transit system to connect its distinctive urban pavilions that are “spread

throughout Los Angeles County, located around metro stops on our growing transit system. The Los Angeles World's Fair seeks to connect on every level-from the physical to the cultural. The unprecedented layout encourages connection like never before!" (Schierbeek).

To realize these goals, the LAWF plans to host a two-year long "county-wide celebration of people, partnerships, and positivity!" ("About Us"). With the ambitious promise of presenting visitors with visions of the future, including

riding hyperloop buses that take you from Downtown Los Angeles to Santa Monica in under three minutes, viewing models and plans for the high-speed rail line that will run from Los Angeles to San Francisco by 2029, or virtually meeting someone in Istanbul via hologram, the Los Angeles World's Fair™ will display innovations in connectivity and transportation like never seen before ("Frequently Asked Questions").

The LAWF has the potential to contribute to the growing presence of rail transit in Los Angeles, while also leaving its own legacy of innovative and sustainable transportation as past World's Fairs have done. However the desire to move Los Angeles towards an enlarged rail-oriented transit infrastructure would be constrained if LAWF planners do not take into account the history and complications of the city's rail transit system.

Los Angeles's Rail History

Los Angeles's development is largely indebted to its transportation infrastructure. Starting from its early expansion with inter-urban rail lines in 1873, public transit defined the sprawling Los Angeles landscape. Shortly thereafter, Los Angeles's was also influenced by the creation of the Arroyo Seco Parkway in 1935, credited as the first freeway linking downtown Los Angeles to the neighboring communities in the San Gabriel Valley (Masters). Following in suit were the creation of the many other freeways making Los Angeles the car-centric city it has

become. The desire for increased rail infrastructure in Los Angeles may seem new and perhaps unfamiliar to Angelenos, however, at one point “Los Angeles once had the largest interurban streetcar network in the United States” (Richmond). It is for this reason that the city’s present and future transportation infrastructure is greatly connected to its past.

Los Angeles’s first rail infrastructure was developed in 1869 and connected “the business community in the city [of Los Angeles] with deep-water anchorages at Wilmington/ San Pedro (Banham 58). The city of Los Angeles had subsequently decided to partner with the Southern Pacific line running from “San Francisco to Yuma” as to not leave them “disconnected from direct access to the transcontinental railroads” (Banham 58). These lines connected cities like Los Angeles and San Francisco to the Midwest, through Kansas and Missouri. According to Banham in *Los Angeles: The Architecture of Four Ecologies*, “the conclusion of the deal was also, as far as anyone can judge, the most important single event in the history of the [Los Angeles] area after the foundation of the pueblo in 1781, and considerably more consequential than anything since” (Banham 59). The aggrandizement of the newly implemented rail system “began to shape the future super city almost at once” (Banham 59). A decade later the joint union between the city of Los Angeles and the Southern Pacific Line brought “five lines radiating from the pueblo towards San Fernando, San Bernardino, Anaheim, Wilmington, and Santa Monica [that] constitute the bones of the skeleton on which the Greater Los Angeles was to be built, the fundamentals of the present city where each of these old lines is now duplicated by a freeway” (Banham 59).

The Southern Pacific rail lines dramatically increased accessibility across Los Angeles County. The implemented railway made it convenient for the first time for Los Angeles residents

to “live in San Bernardino or Santa Monica [considered as] the outer fringes of the central city” (Banham 61). Not only did these lines increase connectivity amongst existing towns within the county, it also “formed centers of settlement and development with an economic and municipal life somewhat independent of downtown” (Banham 61). While this railway line had increased connectivity, there were still areas that were untouched by any sort of public transportation.

Resulting from the need for increased rail development came the Los Angeles Electric Railway Company’s inaugural operations of “the first electric street railway” in Los Angeles in 1886 (Walker 15). The “local electric services by street railways and inter-urban lines” referred to as ‘Yellow Cars’ aimed to make “almost every piece of land in the Los Angeles basin conveniently accessible and thus profitably exploitable” (Banham 63). One of these influential rail lines was George Howland’s 1887 Pico Street line “operating out of downtown to serve the ‘Electric Railway Homestead Association Tract.’ With the creation of this line came the definitive age of the development of Los Angeles” (Banham 61). This line brought rail lines connecting the University of Southern California up to Pasadena “largely by merging and connecting existing local companies” in addition to providing connections for the first time between Hollywood to “Santa Monica with an extension to Ocean Park in 1896” (Banham 63).

The merging of different rail companies continued to occur over the next “fifteen years of wheeling, dealing, buying-out of the Santa Monica network, beating off rivals, consolidations and reorganizations” (Banham 63). This had culminated into the “great merger” birthing the Pacific Electric Railroad in 1901, which led to the installation of the “Big Red Cars” (Banham, 63) providing passenger service until 1961 (Hilton). As seen in the figure below, the Big Red cars canvassed approximately 1,164 miles of track at the time of its greatest extension in 1923,

radiating out from the center and connecting communities across Los Angeles County (Banham 64).

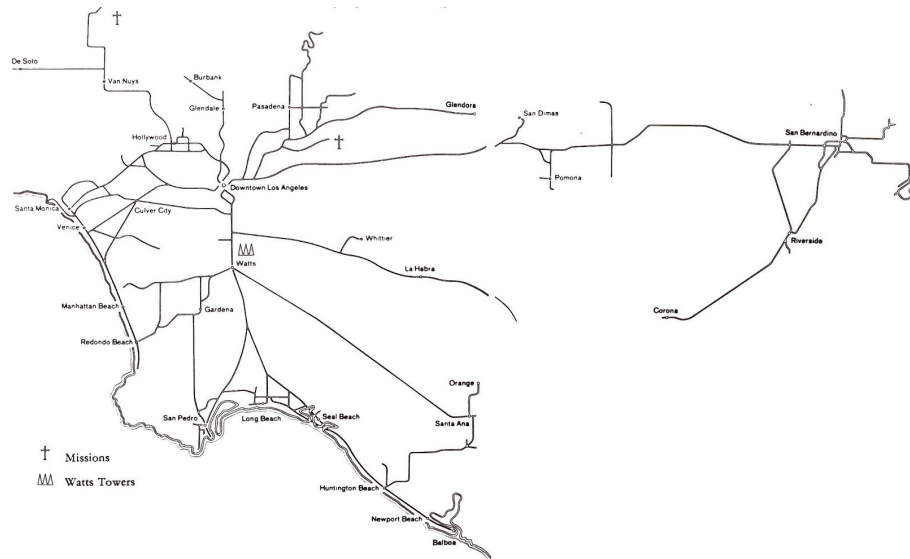


Figure 6. Route map of the Pacific Electric Railroad, 1923. Banham, Reyner. *Los Angeles: The Architecture of Four Ecologies*. Berkeley and Los Angeles: U of California, 1971. Print.

While these routes ran “from one speculative subdivision to another,” the rails were placed on a landscape that was “largely empty, a civic map waiting to be filled in” (Hawthorne). The Big Red Cars brought a newfound freedom to passengers as it had services running down from “the coast of Balboa and along the foot of the Palisades to the mouth of Santa Monica Canyon; up to the valley and to San Fernando; to Riverside, Corona, and San Bernardino; out through La Habra and through Anaheim to Orange; through the foothill cities of the Sierra Madre to Glendora, and via Pasadena to Echo Canyon and Mount Lowe” (Banham 64). The Pacific Electric (PE) not only outlined “the present form of Los Angeles, it also filled in much of its internal topography, since its activities were everywhere involved-directly or otherwise-with real estate” (Banham 64).

While rail had a crucial role in the formation of Los Angeles landscape's, encouraging settlement in previously uninhabited areas and increasing Angelenos' connectivity across the county, problems eventually arose with the streetcars. Transit scholar and former UCLA Economics Professor, George W. Hilton, elaborates on the causes for the streetcars decline:

To some extent, the Pacific Electric's own impact on the geographical properties of Los Angeles was a force for its own decline. The metropolitan area grew up not outward along radial routes as Chicago's did, but rather as a series of separate communities mainly located along Pacific Electric lines which grew together in the course of the area's development, contrary to the expectations of virtually all observers. This pattern meant that Pasadena, Santa Monica, Long Beach and many other communities had sizeable central business districts of their own with extensive retailing, employment and amusement functions. Thus, when the characteristic deconcentration of American cities began, Los Angeles' central business district was a far less important center than its counterparts in all other major cities. The Pacific Electric which was almost exclusively a radial facility to and from that central business district, could only decline in a fashion parallel to electric railway networks elsewhere. As the patronage declined, the Pacific Electric had the usual pattern of disinvestment in facilities (Hilton).

Real estate development was one of the resulting benefits of the railway, as entrepreneurs primarily sought out railroad expansion as economic opportunity, which left little to no room to match "local expectations" (Bottles 27). "Saddled with a high debt load from overexpansion, the carriers found that they could not provide the kind of [transportation] service demanded of them by the local denizens" (Bottles 27). Consequently, as "subdivision and building promoted profitably increased traffic, [real estate development] also promoted more intersections and grade crossings where trains could be held up and schedules disrupted, so that the service began to deteriorate and street accidents began, in the twenties, to give the Big Red Cars a bad name" (Banham 65).

While these streetcars were once considered the city's most efficient means of "rapid, efficient transportation" and a fine way of traversing the county, (Bottles 27) they were later

deemed as “a putrid brand of transportation,” according to the Los Angeles *Record*, thus initiating the battle between trains and cars. Addressing similar concerns for the streetcar’s lack of service was a Venice resident who stated: ‘Is there no relief for the hundreds of citizens of this community who are forced to pay high fares to be handled like cattle’ (Bottles 75). By the 1930’s “there was little reason for the average Angeleno to feel kindly disposed toward the railways” (Bottles, 168) and as a result Angelenos began to “take their cars” (Bottles 54) to “protest the poor quality of rail transit in a much more direct way” (Bottles 54). As a result, civilians stopped taking rail transit all together (Bottles 54). To make matters worse, “the privately owned rail companies were inflating their costs and making it impossible for the city to buy them out. Angelenos were reluctant to subsidize private rail, despite their gripes with service. Meanwhile, both the city and the state continued to invest heavily in freeways” (Novak).

In addition to the general public’s frustration with the railway and the increase in rail ticket pricing, the automobile became “even more convenient in this dispersed city...[and] had begun to steal customers directly from the PE” (Banham 65).

Los Angeles’s Transition Towards the Automobile

According to these narratives, Angelenos accepted the automobile into their lives with open arms, due to their frustration with the PE’s rail service. However, the mass media, including newspapers and the radio, had published a different rendition of the automobile’s popularization in society, known as the “Great Transportation Conspiracy” which is described in writer Guy Span’s *San Francisco Bay Crossings* newspaper article, “Paving the Way for Buses – The Great GM Streetcar Conspiracy” (2003). According to Bradford C. Snell, former assistant

attorney for the United States Senate's Anti-Trust Subcommittee, in his 1974 report, “American Ground Transport—A Proposal for Restructuring the Automobile, Truck, Bus and Rail Industries” “General Motors [was] a sovereign economic state whose common control of auto, truck, bus and locomotive production was a major factor in the displacement of rail and bus transportation with cars and trucks.” Span continues to mention that:

Snell’s 1974 report goes on to craft a plausible case for a vast conspiracy to destroy clean, economic, and user-friendly streetcars with ugly, smelly, and uneconomic buses so more people would buy cars. But there’s more! He also finds GM guilty of building diesel locomotives to eliminate electric freight railways and run up the operating expenses so more railways would either go bankrupt or raise their rates, thus benefiting the truckers (who would buy GM trucks).

This conspiracy pervaded pop culture and framed the plot in the film, *Who Framed Roger Rabbit?* (Harrison). In the film, the scheme is alluded to when the main character, Judge Doom, threatens to destroy Toon Town by having private companies install a freeway system altering the forms of mobility to focus on car-centric means of transportation. In the film’s audio commentary its writers, Jeffrey Price and Peter Seaman, support this conspiracy by saying, “the Red Car plot, suburb expansion, urban and political corruption really did happen. In Los Angeles, during the 1940s, car and tire companies teamed up against the Pacific Electric Railway system and bought them out of business. Where the freeway runs in Los Angeles is where the Red Car used to be” (Zemeckis). While Snell and Span are both convinced of GM’s involvement in having “murdered mass transit” (Jaffe) there are many critics who do not believe that GM is to blame for the transition to automobiles. Among these critics is Professor Hilton:

I would argue that these [Snell's] interpretations are not correct, and, further, that they couldn't possibly be correct, because major conversions in society of this character — from rail to free wheel urban transportation, and from steam to diesel railroad propulsion — are the sort of conversions which could come about only as a result of public preferences, technological change, the relative abundance of natural resources, and other

impersonal phenomena or influence, rather than the machinations of a monopolist (Span 2003).

A Los Angeles transportation official made similar claims to the “natural” transportation transition as “the rail passenger operations of Pacific Electric became obsolete, and economically there was no justification for their perpetuation. As a result, like the horse and buggy, they dropped from the scene” (Harrison). Regardless of mainstream media and the conspiracy surrounding General Motors, Angelenos embraced the automobile and found it to be both as a liberating and effective alternative means of transportation.

The transition to the automobile was also encouraged by federal and state incentives on a government scale through the development of highways in Southern California with President Dwight D. Eisenhower’s System of Interstate and Defense Highways in conjunction with the 1956 Federal-Aid Highway Act. The Federal-Aid Highway Act authorized the building of “41,000 miles of interstate highways” nationwide, greatly shifting the culture of transportation towards that of the automobile (“1941: Federal-Aid Highway Act”).

Given the history of Los Angeles’s evolution in transportation infrastructure, mobility has been foundational in the city’s development and growth. Banham echoes the importance that movement has had in Los Angeles:

One can most properly begin by learning the local language; and the language of design, architecture, and urbanism in Los Angeles is the language of movement... Mobility outweighs monumentality... The city will never be fully understood by those who cannot move fluently through its diffuse urban texture, cannot go with the flow of the unprecedented life. So, like earlier generations of English intellectuals who taught themselves Italian in order to read Dante in the original, I learned to drive in order to read Los Angeles in the original (Banham 5).

Illustrated in Banham's fourth and most unifying ecology "Autopia," automobility is ingrained into the cultural fabric of the city. According to Matt Novak, writing for the Smithsonian Institution, "aside from Detroit, there's no American city more identified with the automobile than Los Angeles" (Novak). Richard Longstreth, author of *The Drive-In, The Supermarket, and the Transformation of Commercial Space in Los Angeles* (2000) illustrates that this culture caught on because the "burgeoning middle class created one of the highest incidences of automobile ownership in the nation, and both the diffuse nature of the settlement and a mild climate year-round yielded an equally high rate of automobile use" (Novak). Los Angeles "unencumbered by the geographic restrictions of places like San Francisco and Manhattan quickly grew outward rather than upward," (Novak) which prompted the growth of automobiles and freeway infrastructure dating back to the early 1920's. Automobiles were seen as part of the transportation solution, when they increased in popularity particularly during the 1950's and 1960's. However in recent years, it became apparent that they instead may be part of a larger problem.

Negative Impacts of the Automobile

What may have originally been considered as a convenient and efficient response to antiquated streetcars has caused a cacophony of health and environmental concerns around the world. According to a yearly report published in 2015 by the U.S. Department of Transportation's Office of Policy Information, there were approximately 3 trillion vehicle miles of travel in the US (December 2015 Traffic Volume Trends). In addition, from January to May 2016, the US has consumed 40,310 trillion British thermal units (Btu) making its energy usage

second only to that of China (Total Energy Consumption). Of the total energy consumption, the transportation sector makes up 28% (Energy Consumption Estimates by Sector, Consumption & Efficiency). Petroleum, a “main source of energy for transportation,” (“Energy Consumption Estimates by Sector, Consumption & Efficiency”) provides approximately 92% of the total energy in the transportation sector, consuming 25,429 trillion Btu of energy in 2015. Overall petroleum consumption in the US in 2015 was approximately 19,530 barrels per day (“Total Energy”). Gasoline, a product from petroleum, is the most commonly used fuel for automobiles. In 2015 it accounted for 56% of total U.S. transportation energy (“Energy Use for Transportation, Use of Energy Explained in the United States Explained”).

These statistics are further amplified on the West Coast, which had a total of 61.6 billion vehicle miles traveled in 2015. Compared to other regions of America, the West had a greater VMT approximately 5% larger than the North-Central region, 21% larger than the South Gulf region, 12% larger than the South Atlantic region, and 60% larger than the Northeast (“December 2015 Traffic Volume Trends”). The state of California specifically contributes to the high number of miles traveled in the Western region, as in 2015 it had the highest amount of vehicles registered (24,487,807) and the most amount of licensed drivers (25,914,851) than any other state in the US (“Statistics for Publication”). This therefore signals that California has many cars on the road representing a large number of people traveling by means of automobile, which further leads to congestion and time likely spent in traffic.

Automobile dependent transportation is especially high in Los Angeles. In 2015, Los Angeles County had the highest amount of registered vehicles in all of California (6,293,639) (“Estimated Vehicles Registered by County”). It is therefore no surprise that automobiles in Los

Angeles County are one of the largest contributors to air pollution. In 2009, Los Angeles had the worst air quality in the nation (“2009 Long Range Transportation Plan”). According to Angelenos “more than 81 percent of Los Angeles County residents surveyed in 2008 agree that air pollution is a serious problem, and the threat of climate change to the economy and our quality of life is serious” (“2009 Long Range Transportation Plan”). These statistics are even more troubling as they exist despite the emission controls and improved air quality over the last thirty years.

One of the main reasons why cars are so harmful to the environment is that they release various chemicals while they are running. The pollutants released and their immediate effects are described in The Sage Handbook of Transportation Studies by Dr. Jean-Paul Rodrigue of Hofstra University (2013):

- **Carbon Monoxide (CO):** Carbon monoxide is a colorless, odorless gas, the result of the incomplete combustion of hydrocarbons. Transportation accounts from 70 to 90% of total carbon monoxide emissions. It is thus the air pollutant the most strongly associated with transportation. Carbon monoxide is often present near major traffic intensive arterials, notably in urban areas. Carbon monoxide is a poisonous gas. When inhaled, it combines with hemoglobin to form carboxyhemoglobin, preventing absorption of oxygen and resulting in asphyxiation. 0.5% of carbon monoxide in air may prove fatal in less than half an hour by transforming over 50% of the hemoglobin in carboxyhemoglobin. Lower concentrations of carbon monoxide (3 ppm) may cause poisoning symptoms and affect people with heart, lung and circulatory system weaknesses. It also effects the respiration of plants by inhibiting photosynthesis. Since carbon monoxide is not chemically very stable, direct global effects are strongly limited (probably non existent). Indirectly, carbon monoxide contributes to the formation of greenhouse gases as a catalyst.
- **Nitrogen Oxide (NOx):** Nitrogen oxide (NO or NO₂) is a brown, odorless gas. A byproduct of combustion when energy is used to oxide nitrogen instead of a hydrocarbon. Transportation accounts from 45 to 50% of total emissions of nitrogen oxides. Other sources are chemicals (notably nitrates) industrial production and combustion of fossil fuels in thermal power plants. Nitrogen oxides are not very harmful to humans (particularly NO), but when released from an internal combustion engine, high concentrations are often toxic. It irritates and infects the respiratory system and the eyes. Some decreases in the ability to resist bacterial infection were also observed when the subject is exposed to significant concentrations of nitrogen dioxide. Nitrogen oxides are

known to prevent the growth of crops and thus reduce agricultural yields. Nitrogen oxides are known to be associated with several global effects and have increased at a rate of 0.2% annually over the last decades. They are a catalyst for ozone, a component of acid rain and a component of smog. Depositions of nitrogen oxides influence the nitrate cycle, particularly in water where it influences algae blooms.

- **Hydrocarbons and Volatile Organic Compounds (HC/VOC):** Hydrocarbons (HC) are a group of chemical compound composed of carbon and hydrogen. When in a gaseous form, HC are called Volatile Organic Compounds (VOC). Several HC and VOC are heavy gases or volatile compounds with a strong odor. They are mostly the result of the incomplete combustion of gasoline or by-products of the petrochemical industry. They include methane (CH_4), gasoline (C_8H_{18}) and diesel vapors, benzene (C_6H_6), formaldehyde (CH_2O), butadiene (C_4H_6) and acetaldehyde (CH_3CHO). Transportation accounts from 40 to 50% of total emissions of HC/VOC. They can be emitted by incomplete combustion (70%), during refueling (10%) or by evaporation from storage units (20%), particularly gas tanks. For instance, a car parked overnight during summer emits approximately 4 grams of HC/VOC. Other important sources are petrochemical (plastics and solvent) industries. All HC/VOC are carcinogen (cases of leukemia linked with benzene) to some extent, fatal at high concentrations, harmful to crops and accumulates within the food chain (poisoning). However, heavy hydrocarbons (like benzene) are far more carcinogenic than light hydrocarbons (like methane). All HC/VOC have several global effects. They are components of smog, catalysts for ozone and components of acid rain.
- **Particulates:** Particulates include various solids in suspension in the atmosphere such as smoke, soot, and dust and results of the incomplete combustion of fossil fuels, notably coal. They may also carry traces of other toxic substances like HC/VOC. Transportation accounts for around 25% of total emissions of particulates. Diesel engines are the main emitters. Other important sources are thermal power plants using coal. Particulates are carcinogen. They are also harmful to lungs tissue and worsen respiratory and cardiovascular problems, notably if their size is smaller than 5 microns. Particulates depositions may alter the aesthetic of structures. The accumulation of particulates in the atmosphere and deposition on leaves may reduce photosynthesis and plant growth.
- **Lead (Pb):** Lead is a toxic metal mainly used as an anti-knock agent in gasoline (Lead tetraethyl - $\text{Pb}(\text{C}_2\text{H}_5)_4$) and in batteries (lead dioxide as an anode and lead as a cathode). Until recently, lead tetraethyl was a main source of atmospheric lead emissions in developing countries. This contribution has dropped in absolute numbers but still accounts for 30 to 40% of total emissions. Batteries are now an important source of lead for transportation, but a very limited amount of this lead is carried through the atmosphere (see water pollution). Extremely poisonous metal. Lead has effects on the metabolism and accumulates in living tissues. May causes anemia, and mental retardation for young children. For instance, an extremely high occurrence of mental retardation in some parts of Mexico city was directly linked with lead poisoning. Small doses may cause behavioral changes. Lead is fixed by plants and animals and recontaminate the food

chain. It has a high potential to accumulate in the environment. Lead can also be transported in the atmosphere over wide.

- **Carbon Dioxide (CO₂):** Carbon dioxide is a colorless, odorless gas that composes 0.04% of the atmosphere. Whenever there is combustion (oxidation) of fossil fuels, there is an emission of carbon dioxide. Important temperature regulator for the atmosphere, keeping it a +15o C instead of -15o C if carbon dioxide was absent. Transportation accounts for around 30% of total carbon dioxide emissions in developed countries (15% worldwide). About 66% of carbon dioxide emissions from transportation come from the combustion of gasoline, 16% from diesel fuel and 15% from jet fuel. Carbon dioxide emissions by transportation have the following modal breakdown: cars (43%), light trucks (20%), heavy trucks (14%), airplanes (14%), rail and marine (7%) and non-oil based (2%). Other significant natural sources are volcanic eruptions and the metabolic respiration of living organisms (including decomposition). Carbon dioxide is a harmless gas and an essential element of photosynthesis. Although limited concentrations of carbon dioxide have no effects on human beings, high concentrations FRIED 64 (5000 ppm) may be harmful by causing breathing disorders. Growing quantities of carbon dioxide in the atmosphere are assumed to be linked with climate change.
- **Ozone:** Ozone is a pale blue gas with a strong odor and a powerful oxidant. It is the most common photochemical oxidant. Ozone is created naturally in the high atmosphere when an oxygen molecule is broken apart by ultraviolet radiation and combines with another oxygen molecule. Ozone is also the result of the action of light over a mixture of HC/VOC and nitrogen oxides in the lower atmosphere. It is thus directly linked with transport emissions, notably in urban areas. Ozone is poisonous, hampers breathing and irritates the eyes and the respiratory system at concentrations higher than 0.15 ppm. The normal/natural concentration is around 0.01 ppm at ground levels. It degrades structures (metal and concrete) through oxidation. It damages crops and vegetation and leads to losses of leafs. Depending on the crops and the concentration involved, ozone may reduce yields from 1 to 20%. Ozone impairs visibility. Ozone is essential in the upper atmosphere, as it absorbs light in the ultraviolet band. A drop of 5% in the concentration of ozone may lead to an increase of 10% of skin cancer and eye cataracts.
- **Chlorofluorocarbons (CFCs):** CFCs are colorless and poisonless gases (or liquids). They are very stable, non-flammable and non-toxic components and they have been widely used as dispersing agents (aerosols) or as refrigerants (notably Freon, R-12). For transportation, motor vehicle air-conditioning systems are the main source and account for about 20% of all CFCs emissions. In fact, during its life cycle, an air-conditioning system will release 100% of its CFCs in the atmosphere. With recent legislations, CFCs emissions have considerably subsided in developed countries but not in developing countries. Because of its chemical properties (stable and non-toxic), CFCs have no noticed effects on living organisms. Current concentrations of CFCs in the atmosphere reach about 0.35 ppm (all types of CFCs) but the most widely used type, R12, has 20,000 times more infrared absorbency than carbon dioxide. Thus one ton of Freon will have the same greenhouse effect than 2,000 tons of carbon dioxide. CFCs reduce the concentration

of stratospheric ozone, which absorbs harmful ultraviolet rays. CFCs may stay in the atmosphere from 70 to 200 years, due to their extremely stable properties. They are a long term component of the atmosphere. CFCs emitted during the 1990s are likely to damage the ozone layer for 200 years. Indirect effects of CFCs (increase in ultraviolet rays exposition) include growths in the incidence of skin cancer, eye cataracts, damage to crops and plants, deficiencies of the immune system and increase of ozone at ground levels (through photochemical smog).

As previously illustrated, vehicles are a main cause of air pollutants. According to the Union of Concerned Scientists, “cars and trucks account for nearly one-fifth of *all* US emissions, emitting around 24 pounds of carbon dioxide and other global-warming gases for every gallon of gas. About five pounds comes from the extraction, production, and delivery of the fuel, while the great bulk of heat-trapping emissions—more than 19 pounds per gallon—comes right out of a car’s tailpipe” (“Cars Emissions and Global Warming”). Based on the average vehicle, one vehicle mile traveled (VMT) emits approximately one pound of CO₂” (2009 Long Range Transportation Plan). With Los Angeles County having an annual average of 330 billion VMT, (“California Transportation by the Numbers”), cars in the county are responsible for 330 billion pounds of CO₂ annually. To give some context, the transportation sector alone in 2015 was responsible for producing approximately 1,820 million metric tons of carbon dioxide (“Total Energy”).

The automobile’s role in releasing harmful chemicals into the atmosphere is clear and can severely harm one’s health. When inhaled, automobile emissions can lead to a variety of human health complications including that of headaches, fatigue, asthma, bronchitis, cardiovascular disease, chronic obstructive pulmonary disease, cancer (“Health Effects from Automobile Emissions”). One of the emissions described above are particulates, which are carcinogenic and can lead to an “increased risk of lung cancer” (Patel). Particulates are also “single handedly

responsible for up to 30,000 premature deaths each year (“Vehicles, Air Pollution, and Human Health”). Los Angeles has been specifically affected by these emissions, as in 2015 the city was ranked as “the most polluted city in the U.S. in terms of ozone in this year’s State of the Air Report by the American Lung Association” (Patel). This is enhanced by Los Angeles’s geography as the heat most intensified in the summer months is enclosed by the region’s mountain topography. In addition, “in Los Angeles County, approximately 1,221,000 children and adults have been diagnosed with asthma, a condition that not only causes respiratory distress, but also is accompanied by costly medications, emergency room visits, and physical limitations on high ozone and heat days, both of which will be further exacerbated by climate change” (Patel). While all Los Angeles County residents are subject to these consequences, the effects will predominately impact “low-income communities and communities of color whose homes are often concentrated in areas of the city with a disproportionate burden of air pollution are also at increased risk of health disparities” (Patel). Given this information, it is necessary from a health perspective to reduce our dependency on the automobile to create communities free from excess pollutants.

Not only are these emissions concerning for human health, but they also play a large role in the degradation of our environment through the Greenhouse Effect and global warming, in addition to depleting the ozone layer. It is no coincidence that one of the photos on the United States Environmental Protection Agency’s webpage for climate change is an image of standstill traffic, as automobiles acting as pollution corridors, are a key source of U.S. Greenhouse Gas Emissions (“Greenhouse Gas Emissions”). The Greenhouse Effect describes the naturally occurring process that warms the earth’s surface where 30% of incoming sunlight gets reflected

back into space through clouds and ice while the remaining 70% of the sun rays is absorbed by the “land, ocean, and the rest of the atmosphere” (Riebeek). The energy absorbed is then radiated out as heat energy, “where much of it is absorbed by water vapor and long-lived greenhouse gases such as carbon dioxide and methane” (Riebeek). These gases, including nitrous oxide and ozone, play a large role in transportation, as mentioned previously, and are known to trap the heat which then radiates it in all directions results in greater heating from the sun. The Greenhouse Effect “is beneficial to life on earth” as it provides appropriate temperatures to sustain life. Over the last 250 years, however, scientists have noticed an “enhanced greenhouse effect” (Riebeek). Due to a variety of anthropogenic reasons, such as increasing dependency on burning fossil fuels or the cutting down of carbon-absorbing forests, since 1750 “carbon dioxide levels have increased nearly 38 percent as of 2009 and methane levels have increased 148 percent” (Riebeek). This enhanced Greenhouse Effect has contributed to global warming, an “unusually rapid increase in Earth’s average surface temperature over the past century primarily due to the greenhouse gases released as people burn fossil fuels” (Riebeek). Between 1906 and 2005, “the global average surface temperature rose 0.6 to 0.9 degrees Celsius (1.1 to 1.6° F) and the rate of temperature increase has nearly doubled in the last 50 years” (Riebeek). Immediate effects of global warming increase the frequency in which extreme climate events take place, including that of floods, hurricanes, fires, while also increasing the rates of ocean acidification, sea level rise, and seawater temperature. These potential ills to society are related to transportation, as in 2014 the sector itself contributed 26% to overall greenhouse gas emissions, (“Sources of Greenhouse Gas Emissions”) according to the Environmental Protection Agency.

Our dependency on fossil fuel also leads to ozone depletion. The Earth's atmosphere is composed of many layers, one of those being the stratosphere, which ranges from six to thirty-one miles from the earth's surface. It is in the stratosphere that the molecule ozone is found. These molecules come together to create the ozone layer that protects "all life from the sun's harmful radiation" ("Basic Ozone Layer Science"). However certain greenhouse gases, such as chlorofluorocarbons and hydrofluorocarbons ("Basic Ozone Layer Science"), which are emissions from vehicles, can lead to ozone depletion. When the ozone is depleted, the layer can no longer protect living organisms from the sun's ultraviolet radiation. Consequently, this affects people, plants, and animals who live under the ozone hole, causing problems from an increased rate of skin cancer, cataracts, and crop damage.

According to Dr. Devki Patel, the Health Ambassador for Physicians for Social Responsibility in Los Angeles, physicians can agree that the "connections between air pollution, climate change, and human health are clear" (Patel). The links between automobile usage and both health and environmental consequences are plentiful, illustrating that this type of mobility directly impacts community health. The ways in which transportation innovation emerges in the next few years will not only alter how residents get from point A to point B, but will carry both severe impacts in the lives of civilians and their encompassing environment.

From Rail to Automobile and Back Again

While Los Angeles residents may have originally opted for automobile transportation after the inter-urban lines failed to satisfy mobility needs, the city is now undergoing a period of rail revival. Angelenos have since exhausted the use of the car-centric model of mobility and

have found mass transit to be a potential solution to their freeway and traffic ridden landscape. In recent years, Los Angeles has had growing government-funded and citizen-led momentum in support of rail transit. Somewhat ironically, the city is reverting to its original form of transportation.

Before analyzing the growth of future Los Angeles's rail transit, it is necessary to evaluate existing mass transit infrastructure. Seen in the figure below, as of 2016 Los Angeles has 6 different metro lines:



Figure 7: Los Angeles Metro Rail Map. "Maps & Timetables." *Metro*. N.p., n.d. Web. 8 Dec. 2016.

the Metro Blue Line (Downtown Los Angeles to Long Beach), the Red Line (North Hollywood to Union Station), the Green Line (Redondo Beach to Norwalk), the Gold Line (East Los Angeles to Asuza), the Purple Line (Wilshire/Western to Union Station), and the recently expanded Metro Expo line (Downtown Los Angeles to Santa Monica) (Maps & Timetables).

Metropolitan Transportation Authority (Metro) operates all these rail services. It is the public transportation-operating agency that “serves as transportation planner and coordinator, designer, builder and operator for one of the country’s largest, most populous counties” (“Overview”). It is responsible for the “continuous improvement of an efficient and effective transportation system for Los Angeles County” (“Overview”). In addition to rail, Metro also operates busways in Los Angeles, including the Orange Line (Chatsworth to North Hollywood) and the Silver Line (San Pedro to El Monte).

Metro’s recently extended Expo line from Culver City to Santa Monica has been met with increased participation from both seasoned riders and transit newcomers, since its opening in May 2016. As a result, just “two months after the debut of light-rail service to Santa Monica, it has become clear that the Metropolitan Transportation Authority does not have enough rail cars to accommodate the Expo Line’s surging ridership” (Nelson). Riders have complained that there is not enough room to stand in the cars, let alone to hold “bicycles, wheelchairs or, at some stations, any more passengers” (Nelson). While these packed cars are certainly a hassle for rail riders, the overcrowding signals an interesting behavioral shift among Angelenos and their decision to go car free, for at least part of their journey.

While Los Angeles’s rail ridership has increased with the new extension of the Expo Line, there are existing barriers that currently prevent the ridership necessary for a large behavioral shift amongst Los Angeles county residents to use mass transit as their primary means of transportation. This would be largely due to the “first-mile, last-mile problem” which illustrates how people are only willing to walk approximately $\frac{1}{4}$ mile or 400 meters to and from public transit stops from their place of residence. Beyond this distance, people are not

comfortable walking to their “necessary fixed route stop” (Gibson). This issue is especially pertinent in the expansive and highly urbanized Los Angeles County. According to the California Planning and Development Report, the “challenge Metro now faces – on a scale arguably larger than that of any other major city – is of getting riders to and from its trains and buses” (Stephens). With long distances, often much farther than ¼ mile, civilians on average are not comfortable walking to and from public transit spots. Approximately 1.5 million Angelenos use Metro every day, which is 7% of the county’s population (“Population Estimates”). It is expected “that many more will use transit – thus reducing congestion and pollution – if transit is easier to find and get to” (Stephens). Due to the first-mile, last-mile connectivity problem seen across Los Angeles, individuals have resorted to driving to public transit hubs. They then proceed to take rail to their end destination. Since residents still have to endure traffic and parking fees, this temporary solution is not very attractive. Since most living communities in Los Angeles are distant neighborhoods or suburbs, not centered around transit-oriented housing development, a barrier to increased regional rail ridership remains. This barrier remains, moreover, despite the Expo Line’s adding “seven light-rail stations and more than six miles of track to the growing Los Angeles County transit network,” (Hawthorne). Whether it is the first-mile, last-mile problem, concerns for safety, long wait times, or overall inconvenience with limited metro stops and rail access across the large county, Los Angeles residents still heavily rely on their automobiles for their primary mode of transportation (Tinoco).

While traffic patterns may indicate that automobiles are used in excess in Los Angeles, for the last 50 years Angelenos have been investing in the future of the city’s transportation systems by supporting sales tax increases to create more varied and sustainable transportation

improvements. This began in 1990 with county voters passing Proposition C. This proposition provided funding “to critical transportation projects and programs, including services to help stranded motorists on freeways, bus and rail improvements and carpool lanes” (“Proposition C”). “Proposition C funds are allocated to a variety of capital and operating projects and programs that improve transit service and operations, reduce traffic congestion, improve air quality, and efficiently operate and improve the condition of streets and freeways utilized by transit” (“Proposition C”).

There are also other traffic-oriented ordinances that have positively affected Los Angeles’s mobility in the past. Proposition A (1980) is another key, voter-supported funding source that was the first of its kind to “generate revenues that were used to build the Metro Rail system and a host of other rail and bus projects” (“Proposition A”). Proposition A is “a half-cent sales tax dedicated to transportation funding [that] has funded municipal transportation projects, improved bus service and initiated plans for a rail system that continues to be expanded today” (“Proposition A”). Proposition A can be credited with helping to develop the “Blue Line light rail to Long Beach in 1990 and the Red Line subway to North Hollywood in 2000” (Cavanaugh). However when Proposition A was first on the ballot in 1968, it was rejected (Cavanaugh). At that point, Angelenos resisted alternative forms of travel.

Over the next 12 years, it seemed that Angelenos had changed their priorities. At this point, the *Los Angeles Times* Editorial Board, which previously unsupportive of Proposition A said “Los Angeles cannot afford to wait any longer to start making a serious investment in a transportation system better suited to an era of tenuous energy supplies” (Cavanaugh). While these changes have increased accessibility to the Los Angeles urban landscape, the region

continues to discover more critical transportation needs than it has money to finance. To resolve these issues and increase rail's popularity among Angelenos, Metro has aimed to "improve mobility, provide more transportation options, stimulate our local economy, and create jobs" through its Long Range Transportation Plan ("Measure M: Metro's Plan to Transform Transportation in LA"). The plan aims to "enhance our public transit program by investing in our bus system while expanding our rail system" ("Measure M: Metro's Plan to Transform Transportation in LA"). These goals were made possible partly due to the Measure R sales tax that took effect in 2009. Voted on and approved by Los Angeles County residents, Measure R is "a half-cent sales tax for Los Angeles County to finance new transportation projects and programs, and accelerate those already in the pipeline" ("Measure R"). While Measure R does not fully fund all projects, it works adjacently with the Measure R Expenditure Plan that "devotes its funds to seven transportation categories as follows: 35% to new rail and bus rapid transit projects, 3% to Metrolink projects, 2% to Metro Rail system improvement projects, 20% to carpool lanes, highways and other highway related improvements, 5% to rail operations, 20% to bus operations, and 15% for local city sponsored improvements" ("Measure R").

The passing of Measure R on the 2009 ballot revealed both the desire and the need that Angelenos sought for a more comprehensive and convenient public transportation system. Measure R provided funding to "synchronize traffic signals, repair potholes, extend light rail with airport connections, improve freeway traffic flow, keep senior/student/disabled fares low, provide clean-fuel buses, dedicate millions for community traffic relief." Most pertinent to the efforts of the LAWF, Measure R also helped "expand subway/Metrolink/bus service" ("Measure R").

The combined sales tax revenues from Proposition A and C, and Measure R in addition to other local, state, and federal dollars, have helped Metro make considerable additions the existing rail network throughout Los Angeles: since 1991 alone,

Metro has extended the Gold Line to run from East LA to Azusa; opened the Silver Line from El Monte to Harbor Gateway Transit Center; opened the Expo Line Extension to Santa Monica; extended the Orange Line to Chatsworth; added ExpressLanes on both the 10 and 110 freeways; started construction on the Crenshaw/LAX, Regional Connector and Purple Line Extension rail projects and expanded bike and pedestrian programs throughout the country” (“Measure M: Metro’s Plan to Transform Transportation in LA”).

Even with increasing the metro rail network in years past, Angelenos “spend an average of 81 hours a year stuck in traffic” (“Measure M: Metro’s Plan to Transform Transportation in LA”). In addition, Los Angeles is expected to grow from its current population of 10.2 million inhabitants to 12.5 million over the next 40 years, making sustainable transportation more of an issue (“Measure M: Metro’s Plan to Transform Transportation in LA”). With increased population, traffic is expected to get even worse. In November 2016 Los Angeles county residents went to the polls to vote on the latest traffic improvement ordinance, Measure M. Measure M’s 69.82 % majority is expected to raise \$120 billion for transportation funding to increase the rail networks and public transportation infrastructure in the city (“Measure M: Metro’s Plan to Transform Transportation in LA”). This measure called for “county voters to raise the countywide sales tax by a half-cent and to continue the existing Measure R half-cent sales tax in perpetuity or until voters decide to end the taxes” (Hymon). With the same missions as Measure R, Measure M, titled the “Los Angeles County Traffic Improvement Plan,” illustrates the growing need for transportation alternatives in Los Angeles (“Measure M: Metro’s Plan to Transform Transportation in LA”). If voters pass Measure M, “county residents would see their

sales tax rise to one cent for transit projects. Measure M also extends Measure R, set to expire in 2039, meaning the one-cent tax would last indefinitely” (Smith).

Voters at the polls were not the only interest groups interested in increasing the sales tax, so were some of Los Angeles’s prominent politicians. Speaking at an event at Pomona College in October 2016, Los Angeles Mayor Eric Garcetti and Congress members Judy Chu, Norma Torres and Grace Napolitano advocated for Measure M and “spoke at the Foothill Gold Line State of the Project 2016, which offered a glimpse of the past, present and future of the San Gabriel Valley light rail line” (Bramlett). While all speakers urged attendees to pass Measure M, it was Mayor Garcetti who “painted a picture of a life made more difficult by endless gridlock, something he said that Measure M will help to alleviate” (Bramlett). Garcetti went on to discuss the burden that Los Angeles traffic has on all those who are affected by it.

If there’s one thing that ties everybody together, it’s the traffic that we are stuck in,” he said. “It is the time away from our families. It’s the job interviews that we miss. It’s the life that we can’t even contemplate doing—taking of a job across town because we wonder whether we’re going to spend our lives being stuck on the road. And I think that the Gold Line Foothill extension shows us what could happen (Bramlett).

That approximately 70 percent of voters supported Measure M indicates that there will be more funding available to support transportation projects “with the Gold Line among the top priorities” ranging from Pasadena to Montclair affecting the greater San Bernardino County (Bramlett). With support from citizens and influential politicians alike, rail transit in Los Angeles is undergoing a transformational change. Even Denny Zane, the executive director of the local transit advocacy group, Move LA, supports Measure M and calls it “transformative” (Bliss). Zane also stated that “right now we’ve got only a handful of stations with connecting rail lines,

the full build-out of Metro's plan puts forth a whole new level of connectivity, and that's the secret sauce of ridership growth" (Bliss).

Through public and political mobilization, it is the hope that Los Angeles can become the connected city of the future. This goal aligns perfectly with the LAWF, as it similarly aims to promote sustainable and innovative forms of mobility in Los Angeles. Serving as a potential catalyst for this rail transit expansion, the LAWF is a cause most Angelenos can rally behind. As Mayor Garcetti indicated, traffic is the uniting force among Los Angeles County residents. While this may be true for the time being in 2016, it is the hope of LAWF planners that connected rail transit will unite Angelenos and replace the gas guzzling road rage that currently does.

The recent expansion efforts of light rail in Los Angeles "is part of a larger restoration, an attempt to dust off and build on a long-buried transit history that makes up much of the basic DNA of L.A. urbanism" (Hawthorne). This movement back to rail transit, according to renowned Los Angeles Times Architecture Critic, Christopher Hawthorne, is "unprecedented in scope" for the "standards of American urban history" (Hawthorne). While the increased momentum for expanded rail infrastructure will increase public transportation across the expansive Los Angeles landscape, technologically speaking it seems like the city is taking multiple steps backwards. Compared to the megacities of the world like Paris or Singapore, known for their elaborate and efficient forms of public rail transportation, Los Angeles seems to be catching up to the present, rather than jumping into the future. In a time where cities are brainstorming for advanced technological infrastructure in the realm of mobility, Los Angeles is taking a step back to retroactively claim and connect to its past. While looking to the future and envisioning new forms of mobility, rail itself may not be the all-encompassing solution many

LAWF members may be hoping for. Given the context of Los Angeles's varied forms of transportation throughout the years from rail to the automobile, it only makes sense given its history that future forms of transportation celebrate this diversity. While the emphasis to expand rail services across Los Angeles County may seem like a revolutionary feat on its own, it is not the technological step that futurists imagine.

Prior to forecasting a vision into Los Angeles's transportation future, it is vital to learn from and correct the mistakes of the past. While it has been over fifty years since the streetcars went out of service in 1961, their initial successes and eventual failures are extremely useful to the City of Los Angeles, and LAWF planners alike. As the city aims to reinvent its past through the expansion of rail transit, it must also consider innovative forms of transportation to transport itself into the future via autonomous cars.

Chapter 3: Transportation at the Los Angeles World's Fair

Autonomous Vehicles

For better or worse, the existing freeway infrastructure has become a symbol of Los Angeles's landscape. While other megacities have monuments as their defining feature, "the freeway is the universal icon for which Los Angeles is described" (Wachs). Given the existing parameters for Los Angeles's built landscape, autonomous vehicles not only present advanced technological progress for the current conception of an independent vehicle, but they can also take advantage of the abundant transportation infrastructure that currently exists in Los Angeles. Autonomous vehicles are unmanned "vehicles which are controlled remotely by an operator. Autonomous vehicles are vehicles which are capable of driving themselves. In order to do this, the vehicle must be able to perceive its environment, make decisions about where is safe and desirable to move, and do so" (Yeomans). While the specifics of the technology of the autonomous automobile lies beyond the scope of my thesis, writer James Armstrong gives a general overview of how this technology works in an article for *The Telegraph*:

Radar sensors dotted around the car monitor the position of vehicles nearby. Video cameras detect traffic lights, read road signs and keep track of other vehicles, while also looking out for pedestrians and other obstacles. Lidar sensors help to detect the edges of roads and identify lane markings by bouncing pulses of light off the car's surroundings. Ultrasonic sensors in the wheels can detect the position of curbs and other vehicles when parking. Finally, a central computer analyses all of the data from the various sensors to manipulate the steering, acceleration and braking (Armstrong).

In addition, cars can have varying degrees of automation, which is further categorized by The National Highway Traffic Safety Administration (NHTSA) below:

- Level 0 (No-Automation): The driver is in complete and sole control of the primary vehicle controls (brake, steering, throttle, and motive power) at all times, and is solely responsible for monitoring the roadway and for safe operation of all vehicle controls.

- Level 1 (Function-specific Automation): Automation at this level involves one or more specific control functions; if multiple functions are automated, they operate independently from each other. The driver has overall control, and is solely responsible for safe operation, but can choose to cede limited authority over a primary control (as in adaptive cruise control), the vehicle can automatically assume limited authority over a primary control (as in electronic stability control), or the automated system can provide added control to aid the driver in certain normal driving or crash-imminent situations (e.g., dynamic brake support in emergencies). The vehicle may have multiple capabilities combining individual driver support and crash avoidance technologies, but does not replace driver vigilance and does not assume driving responsibility from the driver. The vehicle's automated system may assist or augment the driver in operating one of the primary controls – either steering or braking/throttle controls (but not both).
- Level 2 (Combined Function Automation): This level involves automation of at least two primary control functions designed to work in unison to relieve the driver of control of those functions. Vehicles at this level of automation can utilize shared authority when the driver cedes active primary control in certain limited driving situations. The driver is still responsible for monitoring the roadway and safe operation and is expected to be available for control at all times and on short notice. The system can relinquish control with no advance warning and the driver must be ready to control the vehicle safely.
- Level 3 - Limited Self-Driving Automation: Vehicles at this level of automation enable the driver to cede full control of all safety-critical functions under certain traffic or environmental conditions and in those conditions to rely heavily on the vehicle to monitor for changes in those conditions requiring transition back to driver control. The driver is expected to be available for occasional control, but with sufficiently comfortable transition time. The vehicle is designed to ensure safe operation during the automated driving mode.
- Level 4 - Full Self-Driving Automation (Level 4): The vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver¹ will provide destination or navigation input, but is not expected to be available for control at any time during the trip. This includes both occupied and unoccupied vehicles. By design, safe operation rests solely on the automated vehicle system (Preliminary Statement of Policy Concerning Automated Vehicles, 2013).

Most of the research and development currently taking place is aiming for automation according to levels three and four.

Interestingly enough, the automated vehicle was first introduced to the world at the 1939-1940 New York World's Fair, in the Futurama exhibit, seen below.



Figure. 8. Automated Vehicles Display at the 1939-1940 New York World's Fair. Vanderbilt, Tom. "Autonomous Cars Through the Ages." *WIRED*. N.p., 6 Feb. 2012. Web. 21 Nov. 2016.

The presence of the automated car at this world exhibition illustrates how World's Fairs have set the stage for innovative forms of transportation, paving the way for advanced forms of mobility years later. This exhibition can be said to have inspired the creation of the Meadowbrook State Parkway, connecting New York City and Long Island (Rumsey). While it was intended to be complete for the World's Fair in 1939, construction was ultimately finished in 1956. Led by renowned urban planner, Robert Moses, this parkway was a result of an envisioned modern and connected American city.

Since the mid-1900s there have been many advancements in the realm of automobiles, with increasing momentum specifically on autonomous vehicles in the last decade. According to

Tom Vanderbilt of *Wired Magazine*, “just about every traditional automaker is developing its own self-driving model, peppering Silicon Valley with new R&D labs to work on the challenge.” Some of these companies, including, Audi, Tesla, Volvo, BMW, Toyota, General Motors, Mercedes Benz, and Google have been hard at work testing and developing this technology (Armstrong) to have autonomous vehicles available for consumers after the year 2020 (Forecasts). Google’s “self driving Toyota Prius Hybrids already are racking up more miles than the typical Californian driver” (Vanderbilt). These vehicles have already accumulated more than two million “fully autonomous miles on public roads,” the equivalent of 300 years of driving experience (“Monthly Report”). Intel just announced its \$250 million investment in autonomous vehicles through their venture capitalist firm Chipmaker at AutoMobility Los Angeles, a “press and trade show event ahead of the 10-day public Los Angeles Auto Show” (Korosec). Clearly, there is growing momentum supporting autonomous vehicles, not only from tech companies, but also from Los Angeles’s government. Even Los Angeles Mayor Eric Garcetti is an adamant supporter of this transportation technology. He stated Los Angeles “could be the first place really in an urban center where we have autonomous vehicles that are able to be ordered up [like] a car service, right away in a real neighborhood, not just in a protected area” (Metcalf). In 2014, Mayor Garcetti and his government collaborated with UCLA and the city of Westwood “to develop a neighborhood for driverless vehicles” (Metcalf). Additionally, Garcetti has a partnership with Xerox to manage this proposed driverless network in the city (Metcalf). If Mayor Garcetti’s support for autonomous vehicles does not get the message across that autonomous vehicles are imminent, take transportation writer for *WIRED* magazine, Tom Vanderbilt’s word for it: “the autonomous car isn’t just around the corner-it’s here.” With

Google's efforts to essentially create a computer that drives, coupled with the automobile industry's efforts to get vehicles driving more like computers, there has been an increased demand for automated features in vehicles, beyond automatic shifting gears and parallel parking. As Vanderbilt argues, "the world's carmakers have been slowly redefining what it means to be a driver... The more interesting question isn't when we will let go of the wheel completely but what form and purpose the car will have when we finally do." If the investment and research being put into automated vehicle technology is any indication, their presence is imminent. While the exact time of arrival is difficult to estimate, it is worth analyzing what these vehicles can offer and the potential dangers of their technology.

It was Norman Bel Geddes, creator of the 1939 New York World's Fair "Futurama" exhibit, who predicted the beneficial safety features resulting from autonomous vehicle technology. He stated that

these cars of 1960 and the highways on which they drive will have in them devices which will correct the faults of human beings as drivers. They will prevent the driver from committing errors. They will prevent his turning out into traffic except when he should. They will aid him in passing through intersections without slowing down or causing anyone else to do so and without endangering himself or others (Vanderbilt).

While overestimating the time it would take for automated features to be introduced to the public, Bel Geddes was able to articulate the benefits of autonomous vehicles and their ability to reduce the number of accidents taking place on the road. According to the World Health Organization, "about 1.25 million people die each year as a result of road traffic crashes" and "road traffic injuries are the leading cause of death among young people, aged 15-29 years" ("Road Traffic Injuries"). One of the leading benefits of autonomous vehicles is their ability to greatly reduce the amount of traffic related injuries and deaths. According to Bob Joop Goos,

chairman of the International Organization for Road Accident Prevention, nearly 90% of automobile accidents are due to human error (“Human Error Responsible for 90% of Road Accidents”). The rate of human-caused automobile accidents became such a concern that the United Nations dedicated 2011-2020 as the Decade of Road Safety. Automated vehicles can curb these avoidable deaths caused by human error as “machines are much better at following rules than humans” (Armstrong). As of March 2013, Google’s self-driving car had gone “500,000 miles of autonomous driving without incurring in a crash.” While these Google cars have since experienced crashes, in general these vehicles have the ability to brake better, turn smoother, and maintain a better distance from other vehicles. With the proper technology integrated into autonomous vehicles, human driving error could be completely eliminated. “According to a study by the Eno Centre for *Transportation*, if about 90% of cars on American roads were autonomous, the number of accidents would fall from 6 million a year to 1.3 million, and auto-related deaths would fall from 33,000 to 11,300” (Wibberley). Consequently, autonomous vehicles would reduce “casualties to drivers and passengers, and other road users, loss due to damage of the vehicles, reduce insurance premium cost for operators, [and avoid] traffic congestion and additional fuel consumption and pollution caused by the accidents” (Piao et al).

In addition to reducing the number of avoidable accidents on the road, autonomous vehicles have myriad other benefits. First, they are more accessible to all kinds of individuals searching for mobility, as they do not exclude drivers that are either unable to take control of the wheel, if they are too young, too elderly, or have disabilities. According to the RAND Corporation, “Level 4 AV technology, when the vehicle does not require a human driver, would enable transportation for the blind, disabled, or those too young to drive. The benefits for these

groups would include independence, reduction in social isolation, and access to essential services” (Anderson et al, 2014). While mass transit and paratransit agencies already have existing services for disabled people, routes are not direct as they would be with autonomous vehicles. Autonomous vehicles would not only fulfill disability and access laws, but they could deliver disabled people to their exact destination without having to hire another human driver to direct the transportation.

Second, the role of the driver is transformed into the role of the passenger, allowing those inside the vehicle to use their time more productively, by “reading, interneting, telephoning/messaging” (Piao et al). Passengers would not be the only ones to reap the benefits of autonomous vehicles, John Highbarger of University of Texas’ Texas Enterprise foresees some of the other inadvertent benefits of the autonomous car in *Google’s Self-Driving Car: A New Era in Transportation*:

- Bars, restaurants, and the entertainment industry would do better – you don’t need a designated driver for a car that drives itself.
- Companies that drive and embrace the change would prosper.
- Massive amounts of money being spent on new trains and other old-style mass transit projects could be saved. Huge numbers of police officers could be transferred from ticket writing to crime prevention.

Third, automated vehicles will reduce labor costs of vehicle operations as ownership of one’s own personal vehicle may significantly decrease. With the introduction of autonomous vehicles, car ownership is expected to decline “by 43 percent—from an average of 2.1 vehicles to 1.2 vehicles per household” according to researchers at University of Michigan’s Transportation Research Institute state (UMTRI) (Schoettle and Sivak, 2015). A report by Consumer Reports recently projected that, “over the first five years of ownership, the median car

costs more than \$9,100 a year to own.” Therefore, the transition to automated vehicles can lead to less spending on automobile maintenance.

Fourth, these vehicles have the capacity to automatically locate themselves, making it possible for them to “park themselves and then pick the users up later” increasing accessibility to one’s car.

Fifth, autonomous vehicles are much more energy efficient than existing vehicles. In *Autonomous Vehicle Technology: A Guide for Policymakers*, the RAND Corporation observed that “the overall effect of AV technology on energy use and pollution is uncertain, but seems likely to decrease both. First, AV technology can improve fuel economy, improving it by 4–10 percent by accelerating and decelerating more smoothly than a human driver. Further improvements could be had from reducing distance between vehicles and increasing roadway capacity” (Anderson et al, 2014). According to auto industry consultant, Stefan Liske, autonomous vehicles can additionally be helpful “for reducing pollution, for reducing traffic jams, [and] for making the commute more efficient — like for people living in Los Angeles who have a one-and-a-half-hour drive in the morning and a one-and-a-half-hour drive in the evening” (Vanderbilt). With a reduction of energy used from autonomous cars, the ambient air quality would also be highly increased. Marty Meisler, LAWF Sustainability Flex Team Co-Lead agrees stating “autonomous vehicles will do wonders to reduce GHG emissions and congestion” (Meisler). Thus autonomous vehicles reap positive environmental effects.

Clearly autonomous vehicles can provide many benefits to society. However, as with any burgeoning technology that would alter our daily lives, there are some major concerns regarding their functionality. As of 2016, autonomous vehicle safety is not yet certain. It was in 2016 that a

self-driving Tesla car using the Autopilot system had its first fatal crash (Millward). This was the first known fatality over 130 million miles “in which the autopilot system had been used” (Millward). Nevertheless, CEO of Tesla Motors, Elon Musk claims that the autopilot feature with partial autonomy in Tesla vehicles is “50% safer than a human driver.” Musk went on to say “even with our first version, it's almost twice as good as a person” (McGoogan).

The question involving the safety of autonomous vehicles is not the only complication that exists for this technology. As of this date, they are still extremely expensive, costing upwards of \$200,000 per vehicle. In addition, legislative infrastructure must be created in the realm of “progressive policies to allow autonomous vehicles on our roads (they currently require a "safety driver" - a passenger sitting in the driver's seat in case something goes wrong, which undermines the autonomous sharing proposal); and data needs to be managed carefully to protect the privacy and location of users” (Chin). In addition, there is a lot of hesitation in accepting autonomous vehicles as part of our transportation routine. An American Automobile Association survey indicated that approximately “75% of U.S. drivers fear self-driving cars “ (Hsu). While it may take time for the general public to get used to the idea of automated features in their vehicles,

the truth is we have gradually been distancing our level of active engagement with the process of operating a car. We automated the shifting of gears. We went from manual steering to power steering and then finally to “drive-by-wire,” in which the mechanical connection between the steering wheel and the tires was replaced by a series of electrical impulses. We gave up paper maps for digital navigation systems. The hazards of parallel parking have been ironed out by ultrasonic sensors. This year, electronic stability control is standard on vehicles sold in the US for the same reason antilock brakes are standard in Europe: Its algorithms can perform better than humans in emergency maneuvering (Vanderbilt-Let the Robot Drive: The Autonomous Car of the Future).

Another concern related to the looming presence of autonomous vehicles is that the environmental benefit may not be as significant as researchers originally thought. According to the same study by the UMTRI, which stated car ownership would decrease with this technology, “the shift [to autonomous vehicles] could result in a 75-percent increase in individual vehicle usage—from 11,661 to 20,406 annual miles per vehicle (this increase in mileage does not include additional miles that would be generated during each “return-to-home” trip)” (Schoettle and Sivak, 2015). With more cars on the road, autonomous vehicles may not resolve the transportation crisis in Los Angeles, they might even add to it. In an article in *The Guardian*, “Driverless cars-the Future of Transport in Cities” John Chin, managing director and research scientist for the City Science Initiative at MIT Media Lab, states that simply adding a fleet of autonomous vehicles on top of existing transportation infrastructure would “only fuel our automobile-dependent society by reinforcing unsustainable low density, sprawling urban development.” Chin mentions other concerns with the autonomous vehicle:

If we continue to drive alone (as most people do) we would still suffer from congestion and the time, energy, and environmental impact it creates. Improved traffic flow may encourage those used to using public transport to shift to the shared vehicles, once again increasing the volume on our already clogged roads. What's more, customers may now spend even more time in an autonomous vehicle and live further from their destination away since they could now use that time to check email, for example, or even eat a meal.

Based on Chin’s prediction, autonomous vehicles could make Los Angeles more car-centric than it already is in 2016. This could potentially increase the number of cars on the road resulting in automated gridlock. When analyzing the eventual implementation of autonomous vehicles, the literature seemed focused on this form of technology only, not accounting for the integration of these vehicles with existing transportation systems. It is therefore essential that autonomous

vehicles be part of the solution, seamlessly working with other forms of public transit, while being showcased at the LAWF. This cohesion between autonomous vehicles and public transit is crucial, especially with plans for an enlarged rail network due to Measure M's passing on the ballot. It is for this reason, that I propose the implementation of on-demand driverless vehicles, known as the Robotaxi system, to solve the first-mile, last-mile dilemma in Los Angeles.

The Robotaxi

As we have explored previously in Chapter 2, sole reliance on vehicular transportation is a trend that has overstayed its welcome in Los Angeles and new technologies must be introduced to increase mobility. "When the returns from investment in existing technologies, e.g., road expansion, added bus service, new subway lines, etc., begin to diminish, it is appropriate, perhaps even necessary, to consider new and potentially transformative transportation solutions" (Spieser et al.). If automobile technology can advance to a point in which it can become completely autonomous, no longer needing the assistance of a human driver to roam freely, private car ownership may "plummet in favor of faster, better, and cheaper mobility-on-demand services fulfilled by driverless cars" (Mui). With complete automation comes the emerging technology of robotaxis, providing "door-to-door service while enabling significant reductions in transportation cost, enhancing mobility for millions saddled with limited access to private and public transportation, relieving congestion, and reducing the need for parking" (Mui). A fleet of on-call, smartphone-requested robotaxis has already been tested for feasibility by a team of researchers led by Professor Emilio Frazzoli at the Singapore-MIT Alliance for Research and Technology (SMART). In their study, *Toward a Systematic Approach to the Design and*

Evaluation of Automated Mobility-on-Demand Systems: A Case Study in Singapore, researchers estimated “a fleet of 300,000 autonomous shared vehicles could serve the entire population of Singapore (almost 6 million people) with a maximum 15 minute waiting time during peak hours” (Chin). Given these results, robotaxis have the possibility to meet Singapore’s transportation needs while also releasing “the power of the collaborative consumption economy. Imagine the following scenario: a customer uses a smartphone app to request an autonomous shared vehicle, it arrives at your door and drops you to your destination, and the vehicle then either moves on and picks up another customer or parks itself and recharges” (Chin). According to writer Chunka Mui in a *Forbes* article, entitled “Driverless Taxis Might Replace Private Cars and Public Transit,” the robotaxi system resolves the problem of vehicles being parked 90% of the time. Robotaxis could solve this issue as they “would enable much higher utilization by sharing otherwise unused cars. This allows the purchase, maintenance and insurance cost to be spread across a large number of users on a pay-as-you-go basis, thereby increasing access and reducing cost for everyone. Also, since passengers don’t need to find parking, travel times, congestion, cost and space requirements would go down.”

Automated technology is not new to companies like Uber and Lyft. In fact, in 2016, Lyft Co-Founder John Zimmer claimed that “within five years, a majority of ride hailing company Lyft’s rides will be in self-driving cars” (Krisher). Zimmer continued to say, “that personal car ownership will come to an end because autonomous rides will become a cheaper way to travel than owning an automobile.” Lyft is currently testing autonomous vehicles on the streets of San Francisco and Phoenix, with its partner General Motors (Krishner). Zimmer agrees that as the world becomes more urbanized, autonomous vehicles represent solutions to the influx of citizens

who are moving to city centers. Zimmer's comments support the use of autonomous vehicles in places like Los Angeles. According to a new report from real estate data from Realtor.com, "a section of Los Angeles in and around Downtown is predicted to see a veritable explosion in new households, the second biggest in the US" (Barragan). Given the surge of residents expected to move into Los Angeles's downtown region, coupled with LAWF's expected 100 million visitors during 2022-2024, autonomous vehicles and their taxi services certainly would seem to have an important role in redefining the city's mobility.

Startups have already taken to the streets to test robotaxis. In August of 2016, Uber "rolled out their very first batch of 100 driverless taxis, with Travis Kalanick, Uber's CEO, proclaiming self-driving cars are inevitable" (Wibberely). Another startup in the industry, named Zoox, aims to put fully autonomous taxis on the road by 2020.



Figure 9. Design for the Zoox Autonomous Vehicle. Harris, Mark. "Meet Zoox, the Robo-Taxi Start-up Taking on Google and Uber." *IEEE Spectrum: Technology, Engineering, and Science News*. N.p., 20 May 2015. Web. 24 Nov. 2016.

Zoox's experimental robot-taxi is

the brainchild of the Australian designer Tim Kentley-Klay and Jesse Levinson, an engineer who worked at Stanford University with Sebastian Thrun, the first director of

Google's self-driving car program. Their vision is for a sleek, modernistic, deluxe electric taxi with gullwing doors, in which four passengers face one another. The car is code-named L4, a play on the National Highway Traffic Safety Administration's classification of full automation as Level 4. Unlike rival designs, it has no front or rear end but can drive equally well in either direction. It has no windshields facing either way, nor does it have a steering wheel or brake pedal (Harris).

The introduction of robotaxis provides an opportunity for transportation planners to alter the very purpose of vehicles, especially in how they integrate with public transit. This would be especially pertinent given the failings of Los Angeles's transportation infrastructure, specifically with first-mile, last-mile connectivity issues. Integrating fleets of self-driving vehicles within the expanding rail system across Los Angeles would highly increase connectivity for Angelenos. If these robotaxis were to pick up passengers from the end of their rail stop and bring them to their final destination, multimodal transportation would take on an entirely different meaning in Los Angeles. By leveraging the power of technology to eliminate the first-mile, last-mile problem, the following scenario could soon be the future for Angelenos:

Imagine opening a mobile app, telling it where you would like to go, and allowing it to facilitate the entire trip. A vehicle arrives at your location, *not* ¼ mile away at an existing fixed-route transit stop, and takes you to the best fixed-route stop that will fit your trip needs. Your arrival at the fixed-route stop is timed perfectly with the arrival of the bus—no more waiting on the side of the road. You hop on the bus, and are taken the majority of the way on the cheapest possible option: existing fixed-route public transit. At the appropriate time, the app buzzes, letting you know it's time to exit the vehicle where, if necessary, another vehicle is waiting to take you the rest of the way. Simple, inexpensive, seamless transit (Gibson).

Autonomous taxi services are on the horizon, with many potential benefits, one of them being increased mobility, especially when working in collaboration with Los Angeles's existing rail network. The LAWF would be the perfect platform to test, display and support this technology. This fair not only has the potential to serve as a catalyst to increasing rail

connectivity, but also increasing awareness of multi-modal transportation, specifically by investing in and sponsoring autonomous vehicles with the specialized purpose of “enabling technology for widespread car sharing” across Los Angeles County. Given the very nature of the LAWF’s dispersed fairgrounds, robotaxis could take passengers to the various pavilions across the county, in areas where rail or bus transit cannot. It is therefore the LAWF’s duty, centered on connectivity, to support innovative forms of transportation and urge collaboration amongst different forms of sustainable and futuristic technology providers, creating at least a prototype demonstration of robotaxis for the fair.

The Hyperloop

The autonomous vehicle will most likely have a place in Los Angeles’s transportation future, but given LAWF Co-Founder Schierbeek’s statement “Los Angeles will always have an interesting blend [of transportation options] as it continues to build mass transit” (Schierbeek). LAWF has the potential to promote transportation innovation in Los Angeles by projecting what the future of Los Angeles will look like. Given the creative and imaginative nature of Los Angeles, there is no shortage of propositions for what the next big transportation innovations will be. In fact, LAWF officials have been considering the latest buzz in technology, the Hyperloop. “Picture sitting in a pod inside a nearly airless tube that stretches above ground for hundreds of miles. Electric motors inside the 11-foot tube accelerate the pod out of the station and slow it down before arrival. Powerful magnets in the tube levitate your pod so you can hurtle friction-free to your destination at nearly the speed of sound.” The hyperloop could exist in “a lacework of hyperloop transit tubes could spread across the country, mounted high above the

ground on pylons and roofed with solar panels to power the system. Distant cities could become as convenient to visit as the local supermarket. And some of the environmental insult that comes from car and plane exhaust could be swept from the skies” (Shankland). While the hyperloop does suggest ‘hype,’ it has the potential to completely alter transportation for the entire world, especially for the automobile centric Los Angeles.

The hyperloop is the brainchild of Elon Musk, “famous tech visionary and CEO of electric car company Tesla Motors and SpaceX, which aims to build reusable rockets that could ultimately help us colonize other worlds” (Shankland). It comes as no surprise that Musk thinks of his development of the hyperloop as a fifth mode of travel, beyond planes, trains, cars, and boats. In his published paper, *Hyperloop Alpha*, (2013) Musk outlines the results of his team of engineers who spent approximately nine months “roughing out hyperloop tube and pod designs and plotting a route between San Francisco and Los Angeles” which would reduce transit between the two major urban areas to about thirty-five minutes (Shankland). Musk sees the hyperloop as the solution to “existing conventional models of transportation” of rail, road, water, and air. This partly resulted from his aversion to California’s High Speed Rail Project, which seemed preposterous to him, given its \$53 billion dollar price tag, at only 168mph (Johnson). In comparison to the Hyperloop, Musk views current

modes of transport to be either relatively slow (e.g., road and water), expensive (e.g., air), or a combination of relatively slow and expensive (i.e., rail). Hyperloop is a new mode of transport that seeks to change this paradigm by being both fast and inexpensive for people and goods. Hyperloop consists of a low pressure tube with capsules that are transported at both low and high speeds throughout the length of the tube. The capsules are supported on a cushion of air, featuring pressurized air and aerodynamic lift. The capsules are accelerated via a magnetic linear accelerator affixed at various stations on the low pressure tube with rotors contained in each capsule. Passengers may enter and exit Hyperloop at stations located either at the ends of the tube, or branches along the tube length (Musk).

Seen below is a preliminary drawing for the Hyperloop technology from CNET Magazine by McKibillo:

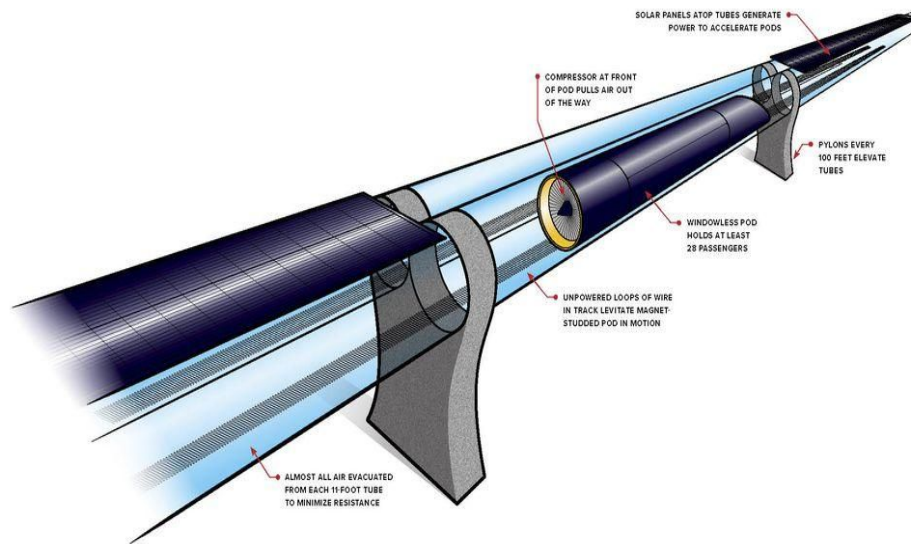


Figure 10. Proposed Hyperloop Technology Structure. McKibillo. Shankland, Stephen. "What the Heck's a Hyperloop?" CNET. N.p., 9 July 2016. Web. 25 Nov. 2016.

Musk and his team of researchers elaborated the specifications for the Hyperloop Transportation System, in their report, *Hyperloop Alpha*, showcasing four main components for a Hyperloop trip from Los Angeles to San Francisco, outlined below:

1. Capsule:

a. Sealed capsules carrying 28 passengers each that travel along the interior of the tube depart on average every 2 minutes from Los Angeles or San Francisco (up to every 30 seconds during peak usage hours).

b. A larger system has also been sized that allows transport of 3 full size automobiles with passengers to travel in the capsule.

c. The capsules are separated within the tube by approximately 23 miles (37 km) on average during operation.

d. The capsules are supported via air bearings that operate using a compressed air reservoir and aerodynamic lift.

2. Tube:

a. The tube is made of steel. Two tubes will be welded together in a side-by-side configuration to allow the capsules to travel both directions.

b. Pylons [which are the upright structures used to support the tubes] are placed every 100 ft (30 m) to support the tube.

c. Solar arrays will cover the top of the tubes in order to provide power to the system.

3. Propulsion:

a. Linear accelerators are constructed along the length of the tube at various locations to accelerate the capsules.

b. Rotors are located on the capsules to transfer momentum to the capsules via the linear accelerators.

4. Route:

a. There will be a station at Los Angeles and San Francisco. Several stations along the way will be possible with splits in the tube.

b. The majority of the route will follow I-5 and the tube will be constructed in the median.

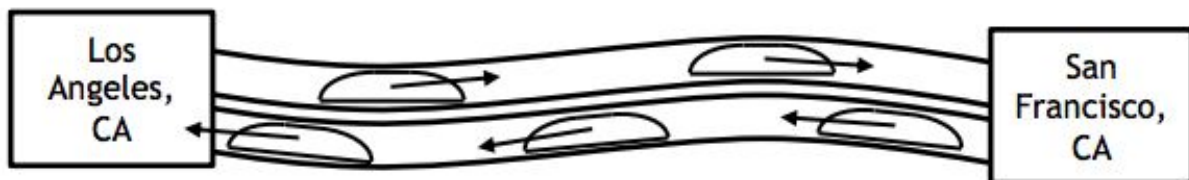


Figure 11. Conceptual Hyperloop Diagram. Musk, Elon. "Hyperloop Alpha." *SpaceX*. N.p., 2013. Web. 25 Nov. 2016.

Stated simply:

the capsule hovers inside a tube with low air pressure, and like a jet plane at high altitude [and] experiences little air resistance. The remaining air in front of the capsule is moved to the back using a compressor, allowing for speeds up to 760 mph, with very low energy consumption. The entire tube system is built on pylons, lowering the cost of land acquisition, making it impervious to weather conditions, earthquakes, and crashes. Hyperloop™ is self-sustaining, due to its use of passive magnetic levitation, regenerative braking, solar power, and other renewable energy resources. Simplified and efficient

design combined with self-sustaining energy strategies results in lower construction and operational costs, translating into low ticket price projections. The capsules can be customized for use-based transport (“Hyperloop Press Kit”).

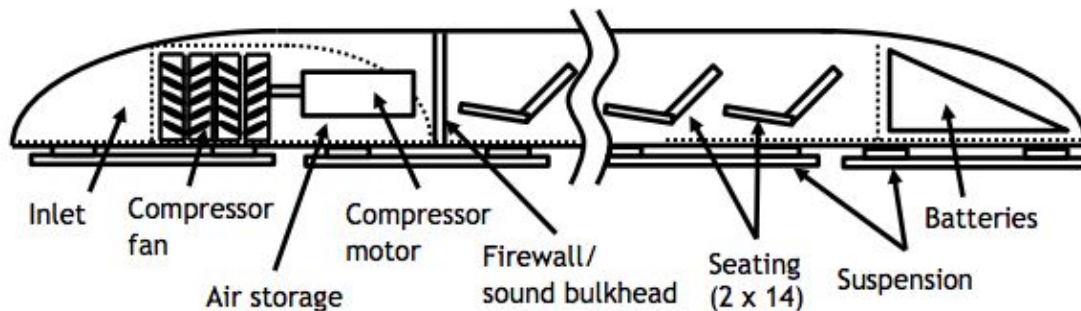


Figure 12. Hyperloop Passenger Capsule (not to scale). Musk, Elon. “Hyperloop Alpha.” *SpaceX*. N.p., 2013. Web. 25 Nov. 2016.

The intricacies of the Hyperloop technology itself are worthy of investigation, however they fall beyond the scope of my thesis. Instead, I will address the benefits of such technology and why it is not currently feasible for consideration for Los Angeles and its potential to host a World’s Fair in 2022.

In an attempt to revolutionize discussion around transportation, Musk opened his designs to the public, encouraging other bright thinkers to take his preliminary designs and logistics to the next level. Musk stated “feedback is desired from the community that can help advance the Hyperloop design and bring it from concept to reality.” Consequently, two major companies have emerged, taking Musk’s initial designs of the Hyperloop further. One of them is Hyperloop One, co-founded in 2014 by Shervin Pishevar and Josh Giegel with the slogan “Be Anywhere, Move Everything, Connect Everyone” (“Our Story”). The Hyperloop One website claims that “the world is ready for a new mode of transportation that will change the way we live. When cities become metro stops regions will flourish” (“Our Story”). Hyperloop One has been supported from approximately one hundred thirty-seven ventures, such as “Khosla Ventures, the

French National Rail Company and GE Ventures” (CNBC). As of 2016, Hyperloop One has raised \$90 million in funding and has begun developing Hyperloop routes across five different countries. The website for the Los Angeles-based company equates this technology as the “broadband for transportation” and instead of selling transportation, they sell time (“Our Story”). As seen in the diagram below, the Hyperloop is 12.3 times faster than the automobile and supposedly surpasses the travel time of an airplane.

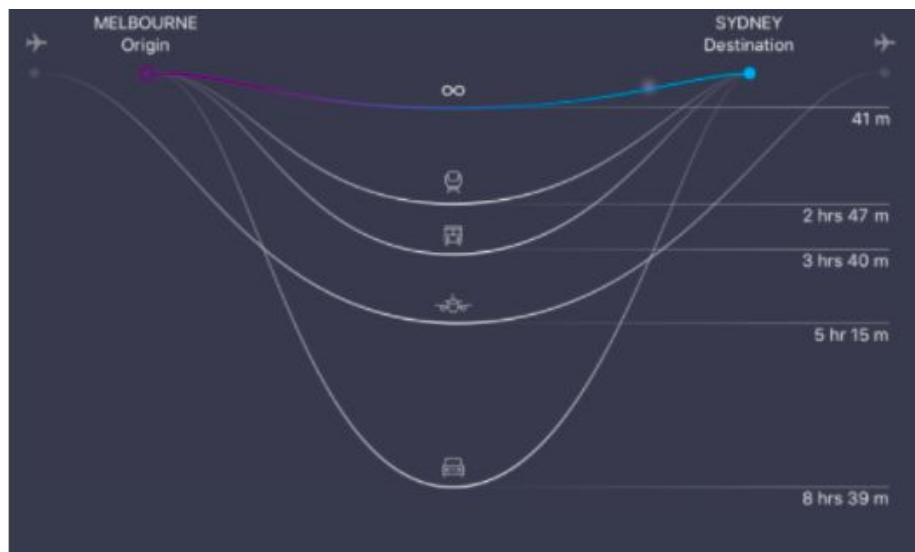


Figure 13. Hyperloop One Travel Time Comparison. “Our Story.” *Hyperloop One*. N.p., n.d. Web. 26 Nov. 2016.

In May of 2016, Hyperloop One had its “first-ever demonstration of a Hyperloop magnetic levitation train in the desert outside Las Vegas” where “Hyperloop One’s test module hit roughly 2.5Gs of acceleration before braking in the sand” (Stella). Technology reporter for *Digital Trends*, Rick Stella, was at the site: “I can vouch that the first Hyperloop prototype is very much real. And the future of transportation technology is quite literally riding on it” (Stella). Stella equated the Hyperloop’s display to that of a rocket launch, as he saw the “aluminum sled shot down the Hyperloop test track and plowed to a sand-aided stop roughly 100 yards later” (Stella).

While it “didn’t get anywhere near the proposed final speeds of around 750 miles per hour, for the first time in the Hyperloop’s short history, it existed somewhere other than on paper” (Stella).

While it may have existed in real life, it was anything but complete. According to

Mashable reporter, Lance Ulanoff, “the test, while fast, was, to be honest, somewhat

underwhelming.” Reaching only the speed of a fast car at 150 mph, there is plenty room for

growth before the test reaches its desired speed.

Another contender in the Hyperloop industry is Hyperloop Transportation Technologies, Inc. (HTT), led by German born, American entrepreneur Dirk Ahlborn. HTT was founded in 2013 with the help of a

JumpStartFund—a unique crowdfunding and crowdsourcing incubator platform that uses collective knowledge and assets to make ideas like Hyperloop™ a reality. HTT is a collaborative organization built within the egalitarian ecosystem of a company that values every one of its contributors—both individual and entity. Collaborations with groups such as Atkins, Leybold Corporation, and Deutsche Bahn have resulted in tremendous advancement of the Hyperloop™ transportation system, setting stage for commitment to an installation in Quay Valley, California. HTT has an exclusive agreement with Lawrence Livermore National Laboratory for use their passive magnetic levitation system as the core of low-cost, safety-conscious construction and design in the Hyperloop™. The company is partnered with more than 600 professional team members who provide the company with engineering, physics, legal, human resources, media relations, logistics, and construction talent to fuel a company that is uniquely collaborative and talent-laden (“Hyperloop Transportation Technologies Press Kit”).

Much like their competitor, HTT also showcases the time saved with the Hyperloop. On their website, HTT markets the Hyperloop as “an entirely new mode of transport that will revolutionize travel by connecting people and goods safely and efficiently” (“Hyperloop”). They aim to offer “transportation with rocket speed,” providing a thirty-minute trip from Washington DC to New York, which would otherwise be a three hour train ride and an hour flight. As illustrated below, this is made possible by HTT’s goal to function at 760 mph, compared to a

plane with speeds of 500mph and a train operating at 200 mph (“Hyperloop”). If this sounds unbelievable, you are right. Currently the Amtrak train that provides rail services between these two east coast cities travels an average 66 mph. An airplane, in contrast, travels roughly 200 mph. While airplane and train speeds may increase depending on distance traveled, this figure overestimates the travel speed between these two short distances.



Figure 14. Hyperloop Transportation Technologies Speed Comparison. “Hyperloop.” *Hyperloop Transportation Technologies*. N.p., n.d. Web. 25 Nov. 2016.

Advantages and Disadvantages of the Hyperloop

The Hyperloop seems to have many potential benefits, of which energy efficiency is perhaps the greatest. Given the negative environmental and health effects of vehicles that were explored earlier in Chapter 2, it is imperative that future transportation technology be sustainable and do so by reducing the cost of energy deployed and the many environmental consequences that result from their use. As a result, Musk envisions the hyperloop as a self-powering system. “By placing solar panels on top of the tube, the Hyperloop can generate far in excess of the

energy needed to operate. This takes into account storing enough energy in battery packs to operate at night and for periods of extended cloudy weather. The energy could also be stored in the form of compressed air that then runs an electric fan in reverse to generate energy” (Musk). Musk projects that each passenger capsule could come equipped with 5,500 pounds of batteries used to power the capsule systems. Initial plans for the Hyperloop, which could transport passengers and vehicles alike, includes an estimated 12,100 pounds of batteries to power the capsule systems. While these batteries are intended to cover the majority of the capsules energy demands, according to Ryan Bradley writing for the *MIT Technology Review*, in his article “The Unbelievable Reality of the Impossible Hyperloop,” relying on solar energy to deliver the sudden bursts of power to the acceleration magnets doesn’t look practical for all places or weather conditions. Considering that the Hyperloop has goals to exist all around the world, weather will greatly impact its capacity to efficiently utilize solar energy.

While the feasibility of the Hyperloop’s renewable energy source remains questionable, compared to the car, airplane, motorcycle, train, and fully electric Tesla Model S vehicle, it appears to have the lowest energy cost. As illustrated in the figure below, a theoretical Hyperloop trip from Los Angeles to San Francisco, in vehicle and passenger forms, consumed the least amount of energy. It stands second only to Tesla’s fully electric Model S vehicle. In comparison to the passenger and vehicle Hyperloop displayed in light blue, the car (with an estimated 30 mph) consumes 3.6 times more energy than the hyperloop (Musk). While the non-electric car is less energy efficient, its estimated 30 mph for the entire journey from Los Angeles to San Francisco is unrealistic. The Interstate 5 highway is 230 of the total 400 miles between these two cities with a speed limit of 70 mph (“From Los Angeles to San Francisco”).

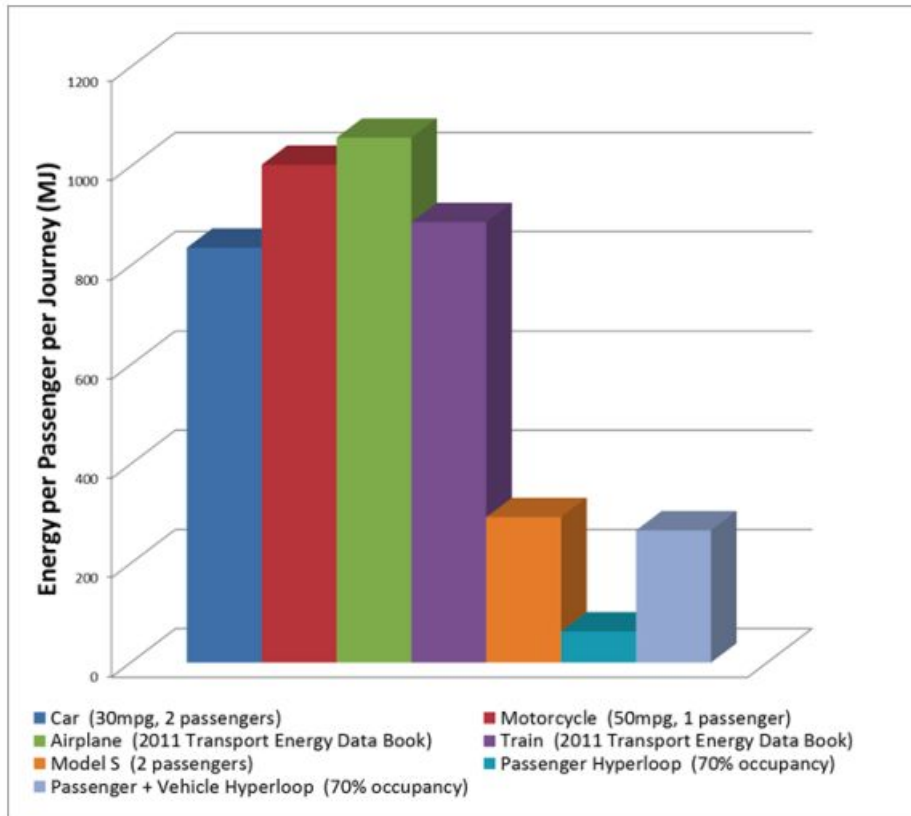


Figure 15. Energy cost per passenger for a journey between Los Angeles and San Francisco for various modes of transport. Musk, Elon. "Hyperloop Alpha." *SpaceX*. N.p., 2013. Web. 25 Nov. 2016.

Another benefit of the Hyperloop is the facility with which the technology may be utilized by other cities around the world.. As stated by Hyperloop One Co-Founder, Pischevar, this technology "frees you from time and space. You could redesign cities not around cars anymore but around people, cities that are green and clean. The idea is that we can live and work anywhere" (Collins). The possibilities of redesigned cities around this possible fifth form of transportation are quite endless, providing urban planners a white canvas in terms of new reconstruction efforts for the metropolitan landscape. Regardless, this proposed infrastructure is theoretical. Hyperloop's technology is proposed to connect various cities, from Los Angeles to San Francisco and Washington D.C. to New York City, and so on, but it is not clear how it

would connect short distances within the same city. HTT even published a map, seen below, envisioning a fully functional system spread across the United States.

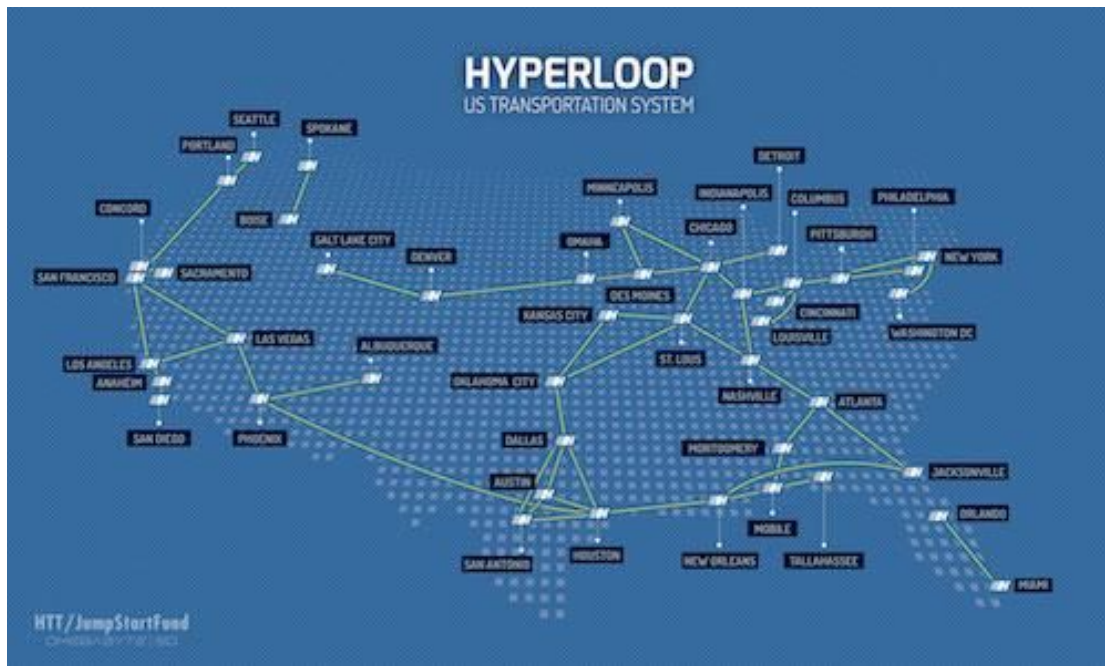


Figure 16. Projected Hyperloop U.S Transportation System. “Hyperloop Press Kit.” *Hyperloop Transportation Technologies*. N.p., n.d. Web. 26 Nov. 2016.

What seems to be a continuing theme surrounding the Hyperloop is the absence of details. Nowhere to be found on HTT’s website are further specifics outlining the timeline for this infrastructure in the US, nor are the costs for this project. Another crucial detail that must be elaborated upon is how the Hyperloop would impact a city’s transportation infrastructure. The LAWF has claimed that with the Hyperloop, passengers could be transported from downtown Los Angeles to the beach in 3 minutes, what could otherwise easily be over an hour car ride with LA traffic (“Frequently Asked Questions”). As incredible as this sounds, it is completely theoretical. It still remains uncertain whether the Hyperloop would be used for long or short distance transport and whether these stations will be built within Los Angeles County itself.

A technology as advanced as this comes with a cost. According to SpaceX, Hyperloop One, and Hyperloop Transportation Technologies, it aims to be extremely affordable to construct and thereby also ride. For Musk, “it is important to make the tube as low cost and simple as possible.” Musk and his team of engineers elaborated on the economic feasibility of the project, stating:

the pods and linear motors are relatively minor expenses compared to the tube itself – several hundred million dollars at most, compared with several billion dollars for the tube. Even several billion is a low number when compared with several tens of billion proposed for the track of the California rail project. The key advantages of a tube vs. a railway track are that it can be built above the ground on pylons and it can be built in prefabricated sections that are dropped in place and joined with an orbital seam welder. By building it on pylons, you can almost entirely avoid the need to buy land by following alongside the mostly very straight California Interstate 5 highway, with only minor deviations when the highway makes a sharp turn (Musk).

With pylons at the base, the Hyperloop has the capacity to be “built over land already in use for public transportation, such as in the medians of freeways minimizing footprint” (Hyperloop One). Such a strategy might help to reduce costs to both the builders and passengers. Beyond SpaceX’s cost predictions, Hyperloop Transportation Technologies similarly echoes cost efficient goals:

A full-scale Hyperloop™ route between Los Angeles and San Francisco, for example, is estimated to cost between \$7 and \$16 billion. To put that number into perspective, the initial operating segment of the California High Speed Rail between Madera and Bakersfield is projected at \$6 billion. The overall cost of the completed California High Speed Rail is nearly \$68 billion. Hyperloop™ ticket prices are not yet fixed, but initial estimates indicate a one-way ticket price below \$30 dollars for a Los Angeles – San Francisco route (“Hyperloop Transportation Technologies Press Kit”).

In comparison to the Californian High Speed Rail projected ticket price, the Hyperloop projected ticket price is expected to be cheaper by \$50-60 per ticket. Hyperloop One also spreads this

message of economic feasibility as they display on their website's homepage that the "Hyperloop is a new way to move people and thing at airline speeds for the price of a bus ticket" (Hyperloop One).

Musk and his team at SpaceX believe that the Hyperloop could be a transportation alternative that is "safer, faster, lower cost, more convenient, immune to weather, sustainably self-powering, resistant to earthquakes, [and] not disruptive to those along the route" (Musk). These intentions make the Hyperloop appear too good to be true, with little evidence proving otherwise. The Hyperloop is still in its infancy and accordingly has no shortage of critics; one of which is the tech media, who believes that Musk's paper, *Hyperloop Alpha*, was only a rough sketch of the project and that "the most important elements of the plan—its speed and price—have been vastly oversold" (Morris).

Another one of the most vocal critics is Alon Levy, a researcher in theoretical mathematics at the Sweden's Royal Institute of Technology, who analyzes public transit issues at the blog *Pedestrian Observations* (Morris). According to his blog post, "Loopy Ideas Are Fine, If You're an Entrepreneur," Levy believes there are four major faults in the Hyperloop project: "that Hyperloop a) made up the cost projections, b) has awful passenger comfort, c) has very little capacity, and d) lies about energy consumption of conventional HSR [High Speed Rail]."

Regarding price, Levy argues that there is no "systematic attempt at figuring out standard practices," meaning that the projected prices are at the discretion of Musk. Since this article was posted, both Hyperloop One and Hyperloop Transportation Technologies have endorsed extremely economical prices, which is of course in their best interest. Musk also highly underestimated the cost of the Hyperloop at its projected endpoint in San Francisco. Especially

on account of how it is currently unclear exactly where the Hyperloop would end. According to transportation planner, Matt Johnson:

some maps show the line crossing the San Francisco Bay either on or adjacent to the Bay Bridge. But his cost projections don't mention the expense of crossing the bay. Other maps show a terminal south of Oakland. So either his Bay Area station will be in the East Bay, requiring a transfer to BART to reach San Francisco, or he's lowballing the cost of the project. The 11-year long effort to rebuild the eastern span of the Bay Bridge has cost \$6.3 billion, so another crossing won't be cheap. Of course, there's nothing technically infeasible about extending the Hyperloop into downtown Los Angeles or San Francisco. But it would significantly increase the costs of the project. The California High-Speed Rail's sections in the San Joaquin Valley are also extremely cheap. If the HSR started in Sylmar and ended in Oakland, it would be significantly cheaper, too. While the cost of getting all the way downtown is already factored into the HSR project, it's not part of the Hyperloop proposal (Johnson).

Levy also questions the assumed comfort for the passenger on the Hyperloop. He claims that at the proposed speeds, passengers will suffer motion sickness and refers to it as “a barf ride” (Levy). Levy criticizes the capacity of the Hyperloop, as well. He argues “the capsules are inexplicably very short, with 28 passengers per capsule. The proposed headway is 30 seconds, for 3,360 passengers per direction per hour. A freeway lane can do better: about 2,000 vehicles, with an average intercity car occupancy of 2” (Levy). Levy argues the proposed rail system too can carry at least as many passengers as the Hyperloop, if not more, with “2,000 passengers per direction per hour: 12 trains per hour is possible, and each train can easily fit 1,000 people.” Additionally, Levy questions the safety of the 30-second stop time claiming “it is well beyond the limit of emergency braking” and with speeds up to 760 mph, the braking time would be at least 70 seconds. To make matters worse, and “to avoid a pileup in the case of one pod’s catastrophic failure, follow distances would need to be more than doubled—and passenger

volume halved. That means the Hyperloop could carry only around 10% as many people as high speed rail” (Morris).

Levy criticizes Musk’s aversion to California’s High Speed Rail (HSR) project, which is expected to transport passengers between Los Angeles and San Francisco in three hours by the year 2029. In the Hyperloop whitepaper, Musk stated that the HSR “would build a bullet train that is both one of the most expensive per mile and one of the slowest in the world” (Musk). Shortly after that statement the head of the California HSR stated that Musk and his calculations are incorrect. Critics like Levy counter that the Hyperloop’s success would prevent HSR from advancing, stating this is Musk’s grand attempt at creating a “distraction” for other forms of rail (Levy). Levy argued that the Hyperloop is “reducing political support for high speed rail in certain communities, like among very techy booster types in Silicon Valley.” While the possibility of a Hyperloop connecting the downtowns of Los Angeles and San Francisco sounds ideal on paper, upon closer examination, there is a lot of work to be done.

The Hyperloop has the potential to radically alter transportation for centuries for come; however, its ambiguity leaves much to be undertaken before it its implementation in any city, let alone Los Angeles for the World’s Fair. The many concerns with the Hyperloop technology make its fully functional and cost efficient debut in 2022 highly improbable. While this fifth mode of transportation may not be operational to physically transport LAWF passengers throughout Los Angeles, the Hyperloop still has the possibility to take visitors to other worlds through its display at a pavilion as part of the World’s Fair, albeit constrained to demonstration only capacity. Highlighting the potential for future transportation, it has the ability to captivate visitors and unite them around sustainable mobility alternatives.

The goals of the Hyperloop, whether stemming from Elon Musk, Hyperloop One, or Hyperloop Transportation Technologies, are very similar to the aims of the World's Fair. With the common goal of increased connectivity, their partnership could create monumental progress for the future of transportation. The Hyperloop's presence on display would be facilitated by LAWF's friendly presence with Hyperloop Transportation Technologies CEO, Dirk Ahlborn. According to LAWF Co-founder, Schierbeek, the LAWF has had preliminary conversations with Ahlborn. Ahlborn has actually presented at one of LAWF's symposiums in 2015 (Schierbeek). Ideally, Los Angeles will one day become a testing site for developing this technology, given the large amount of freeway infrastructure already in use that the Hyperloop's elevated pylon structure can build over, as seen in the figure below.



Figure 17. An Envisioned Hyperloop in Los Angeles, CA. "Hyperloop." *Hyperloop Transportation Technologies*. N.p., n.d. Web. 25 Nov. 2016.

While a Hyperloop in Los Angeles by 2022 may exist only in the imagination of Hollywood's brightest, there is no way of predicting what may come of this burgeoning technology over the next fifty years. Nevertheless, in the short-term it is much more feasible for the autonomous car and the robotaxi system to provide Los Angeles with alternative transportation solutions it currently requires.

Conclusion

A 2022 World's Fair in Los Angeles may accelerate the development of sustainable transportation, both locally and abroad. Los Angeles is uniquely poised to deliver innovative and sustainable solutions for urban mobility, given the fundamental and contentious influence that rail transit and the automobile have had on its own evolution. As my research suggests, the Los Angeles World's Fair may facilitate key breakthroughs in rail and autonomous transportation technology by leveraging the city's history, its current mobility crisis, and the vast array of resources within its reach.

With the hope that Los Angeles does embrace these pioneering forms of mobility, the LAWF presents an opportunity for the city to completely rebrand itself. Instead of being home to the nation's worst traffic and air pollution, the LAWF could significantly ameliorate the world's perception of Los Angeles. Hosting America's first World's Fair in over thirty years would also give Los Angeles international acclaim as the innovative, sustainable, and connected city that it aims to be. With the emergence of increased mobility, Los Angeles could become the model city that other large metropolises look to when aspiring to improve their own transportation grids. Los Angeles, unlike San Diego and San Francisco, has never hosted a World's Fair before and is ready to take on the challenge.

While the LAWF does have the potential to improve the city's mobility, it still remains uncertain whether Los Angeles will actually be able to host the World's Fair in 2022. Again, this is partly due to the fact that the United States is not a member of the BIE. Planners of the LAWF therefore have two diverging paths to choose from. They may either urge the American government to rejoin the BIE and abide by their regulations. Otherwise, they can hope that the

BIE independently recognizes a portion of their proposed two year long exhibition. The latter has had precedence, as the New York World's Fair was officially recognized by the BIE after its opening (Schierbeek). Another factor that may impede the World's Fair from occurring is whether or not Los Angeles is chosen to host the 2024 Olympics. Los Angeles is currently being considered for the Olympic bid, along with other cities such as Paris, Rome, and Budapest. If Los Angeles is selected by the International Olympic Committee in September of 2017, ("Candidature Process 2024") it "will be huge and determinative" in LAWF proceedings (Meisler). While the LAWF aims to run from 2022 to 2024, it could then pass the baton over to the Olympics, which will begin that same year. According to Meisler, this does not seem feasible as there will be "no oxygen left since all the city's resources will be invested in making the Olympics happen" (Meisler). Accordingly, if Los Angeles does become the host of the 2024 Olympics, it could actually delay the World's Fair until after the Olympics.

Even if the LAWF does not take place in 2022, however, my investigation into alternative modes of transportation remains relevant. With sustainable transportation becoming increasingly important to cities and suburbs around the world, it is necessary to account for the weaknesses of Los Angeles's transportation system and note the potential for its growth. If Los Angeles hosts any mega-event in the future, whether it's a World's Fair or the Olympics, it must find creative solutions to accommodate the millions of visitors that would come to the city, making large infrastructural changes to its current transportation grid both necessary and time-sensitive.

Despite the grandiose ambitions of the LAWF and the various challenges it faces, a World's Fair has the potential to galvanize and unite Angelenos, connecting the city and

changing the ways in which people move across the region. The resurgence of rail transit from years past, along with the promise of an autonomous motor city of tomorrow, has the potential to give Los Angeles the transportation renaissance it so desperately needs.

WORKS CITED

- “About the Monorail.” *Seattle Monorail*. N.p., n.d. Web. 23 Oct. 2016.
- Adams, Judith A. “The Promotion of New Technology Through Fun and Spectacle: Electricity at the World’s Columbian Exposition.” *The Journal of American Culture* 18.2 (1995): 45–55. Web.
- “A Short History of Expos.” *Bureau International des Expositions*. N.p., n.d. Web. 18 Oct. 2016.
- Aenlle, Conrad De. “World’s Fairs and Their Legacies.” *The New York Times* 1 May 2015. *NYTimes.com*. Web. 23 Oct. 2016.
- Ambrose, Stephen E. *Nothing like It in the World: The Men Who Built the Transcontinental Railroad 1863-1869*. Simon and Schuster, 2001. Print.
- Anderson, James M. et al. “Autonomous Vehicle Technology A Guide for Policymakers.” 2016. Web. 22 Nov. 2016.
- Armstrong, James. “How Do Driverless Cars Work?” *The Telegraph* 1 July 2016. *www.telegraph.co.uk*. Web. 21 Nov. 2016.
- Auerbach, Jeffrey A. *The Great Exhibition of 1851: a nation on display*. Yale University Press, 1999.
- Banham, Reyner. *Los Angeles: The Architecture of Four Ecologies*. Berkeley and Los Angeles: U of California, 1971. Print.
- Barboza, David. “Shanghai Expo Sets Record With 73 Million Visitors.” *The New York Times* 2 Nov. 2010. *NYTimes.com*. Web. 9 Oct. 2016.
- Barragan, Bianca. “Area Around DTLA Is US’s Second Biggest ‘Boom Town.’” *Curbed LA*. N.p., 19 Apr. 2016. Web. 24 Nov. 2016.
- “Basic Ozone Layer Science.” Overviews and Factsheets. *US Environmental Protection Agency*. N.p., n.d. Web. 15 Nov. 2016.
- Berger, Knute. “Back to the Future: Why Seattle’s World’s Fair Mattered.” *Seattle Magazine*. N.p., Feb. 2012. Web. 30 Nov. 2016.
- Black, William. “Sustainable Transportation: A US Perspective.” *Journal of transport geography* 4.3 (1996): 151–159. Web.

- Bliss, Laura. "Los Angeles Wants a Transit-Themed World's Fair, and It Might Actually Be a Great Idea." *CityLab*. N.p., 20 Apr. 2015.
- Bolotin, Norm, and Christine Laing. *The World's Columbian Exposition: The Chicago World's Fair of 1893*. University of Illinois Press, 1992. Print.
- Bottles, Scott L. *Los Angeles And The Automobile : The Making Of The Modern City*. Berkeley: University of California Press, 1987. *eBook Collection (EBSCOhost)*. Web. 8 Nov. 2016.
- Bradley, Ryan. "The Unbelievable Reality of the Impossible Hyperloop." *MIT Technology Review*. N.p., 10 May 2016. Web. 28 Nov. 2016.
- Bramlett, Matthew. "Measure M Gets Strong Support from High-Profile Politicians." *Claremont Courier*. N.p., 20 Oct. 2016. Web. 1 Nov. 2016.
- "California Transportation by the Numbers." *United States Department of Transportation, Office of the Assistant Secretary for Research and Technology*. N.p., n.d. Web. 14 Nov. 2016.
- "Candidature Process 2024." *International Olympic Committee*. N.p., 26 July 2016. Web. 2 Nov. 2016.
- "Car Emissions and Global Warming." *Union of Concerned Scientists*. N.p., n.d. Web. 14 Nov. 2016.
- Cavanaugh, Kerry. "Are Angelenos Still an 'Automotive People?' Measure M Will Tell." *latimes.com*. N.p., 24 Oct. 2016. Web. 1 Nov. 2016.
- "Century 21 World's Fair." Seattle.gov. *Seattle Municipal Archives*. N.p., n.d. Web. 30 Nov. 2016.
- Chin, Ryan C. "Driverless Cars - the Future of Transport in Cities?" *The Guardian* 24 Feb. 2014. Web. 22 Nov. 2016.
- "Classical KUSC on Twitter." *Twitter*. N.p., n.d. Web. 21 Oct. 2016.
- Collins, Katie. "Hyperloop Hype: Visions of a 'Vomit-Free' Supersonic Future." *CNET*. N.p., n.d. Web. 26 Nov. 2016.
- "Columbian Exposition - Transportation Building." Domu. N.p., n.d. Web. 6 Nov. 2016.
- "Connecting Minds, Creating the Future." *Bureau International des Expositions*. N.p., n.d. Web. 4 Nov. 2016.
- Corbusier, Le. *The City of To-morrow and Its Planning*. Cambridge, MA: M.I.T., 1971. Print.

- “Cost of Vehicle Ownership.” *Consumer Reports*. N.p., Aug. 2012. Web. 22 Nov. 2016.
- Crystal Palace: A History.” BBC. N.p., 24 Sept. 2014. Web. 20 Oct. 2016.
- Cundill, Henry et al. “Los Angeles World’s Fair 2022: Building A Carbon Model.” 25 May 2016: n. pag. Print.
- De Aenlle, Conrad De. “World’s Fairs and Their Legacies.” *The New York Times* 1 May 2015. *NYTimes.com*. Web. 20 Oct. 2016.
- “December 2015 Traffic Volume Trends.” *Policy | Federal Highway Administration*. N.p., Dec. 2015. Web. 11 Nov. 2016.
- De Groote, Patrick. “A Multidisciplinary Analysis of World Fairs (= Expos) and Their Effects.” *Tourism Review* 60.1 (2005): 12–19. Web.
- “Disneyland Monorail.” *Disneyland*. N.p., n.d. Web. 30 Nov. 2016.
- “Energy Consumption Estimates by Sector, Consumption & Efficiency.” *U.S. Energy Information Administration (EIA)*. N.p., 26 Aug. 2016. Web. 11 Nov. 2016.
- “Energy Use for Transportation, Use of Energy Explained in the United States Explained.” *U.S. Energy Information Administration (EIA)*. N.p., n.d. Web. 14 Nov. 2016.
- “Estimated Vehicles Registered By County.” *State of California Department of Motor Vehicles*. N.p., 2015. Web.
- “World’s Columbian Exposition.” *Expo Museum*. N.p., n.d. Web. 21 Oct. 2016.
- “Expo Timeline.” *Bureau International des Expositions*. N.p., n.d. Web. 7 Nov. 2016.
- Falzon, Edward. “What Are the World’s Best Metro Systems?” *CNN Travel*. N.p., 9 Jan. 2013. Print.
- “Frequently Asked Questions.” Los Angeles World’s Fair. N.p., n.d. Web. 22 Sept. 2016.
- “Film.” Where’s the Fair? N.p., n.d. Web. 24 Oct. 2016.
- Findlay, John M. “The Off-Center Seattle Center: Downtown Seattle and the 1962 World’s Fair.” *The Pacific Northwest Quarterly* 80.1, 1989. 2–11. Print.
- . *Magic Lands*. University of California Press, 1993. Print.
- Fotsch, Paul Mason. “The Building of a Superhighway Future at the New York World’s Fair.” *University of Minnesota Press* 48. Cultural Critique, 2001. 65–97. Print.

- “Forecasts.” *Driverless car market watch*. N.p., n.d. Web. 23 Nov. 2016.
- “From Los Angeles to San Francisco.” *MapQuest*. N.p., 28 Nov. 2016. Web. 28 Nov. 2016.
- Garcetti, Eric. Plenary and Celebration, Greenbuild International Conference and Expo, 9 Oct. 2016, Microsoft Theater, Los Angeles, CA. Speech.
- “Getting To & Around Seattle.” *Visit Seattle*. N.p., n.d. Web. 22 Nov. 2016.
- Gibson, Alex. “Eliminating Public Transit’s First-Mile/Last-Mile Problem.” *TransLoc*. N.p., 26 Jan. 2016. Web. 3 Nov. 2016.
- Green, Amanda. “You Owe Your Daily Routine To The World’s Fair.” *Popular Science*. N.p., 4 May 2015. Web. 28 Sept. 2016.
- “Greenhouse Gas (GHG) Emissions.” *US Environmental Protection Agency*. N.p., n.d. Web. 8 Dec. 2016.
- Harfield, Dave. “How Monorails Work.” *How It Works Magazine*. N.p., 26 July 2013. Web. 23 Oct. 2016.
- Harris, Mark. “Meet Zoox, the Robo-Taxi Start-up Taking on Google and Uber.” *IEEE Spectrum: Technology, Engineering, and Science News*. N.p., 20 May 2015. Web. 24 Nov. 2016.
- Harrison, Scott. “Tracking the Slow Decline of the Pacific Electric Railway Red Cars.” *latimes.com*. N.p., 2 Jan. 2016. Web. 6 Nov. 2016.
- Hawthorne, Christopher. “Why the Expo Line to Santa Monica Marks a Rare Kind of Progress in American Cities.” *Los Angeles Times. LA Times*. Web. 9 Oct. 2016.
- “Health Effects from Automobile Emissions.” *Washington State Department of Ecology*. N.p., n.d. Web. 14 Nov. 2014.
- Highbarger, John. “Google’s Self-Driving Car: A New Era in Transportation.” *Texas Enterprise, The University of Texas at Austin*. N.p., n.d. Web. 22 Nov. 2016.
- Hilton, George W. “What Did We Give Up With the Big Red Cars?” *Peter Gordon’s Blog*. N.p., n.d. Web. 6 Nov. 2016.
- “History of Biodiesel Fuel.” *Pacific Biodiesel*. N.p., n.d. Web. 11 Oct. 2016.

- Hsu, Jeremy. "75% of U.S. Drivers Fear Self-Driving Cars, But It's an Easy Fear to Get Over." *IEEE Spectrum: Technology, Engineering, and Science News*. N.p., 7 Mar. 2016. Web. 23 Nov. 2016.
- Huenemann, Ralph William. *The Dragon and the Iron Horse: The Economics of Railroads in China, 1876-1937*. Vol. 109. Harvard University Council on East Asian Studies, 1984. Web.
- "Human Error Responsible for 90% of Road Accidents." *Law Offices of George T. Bochanis*. N.p., 19 May 2016. Web. 21 Nov. 2016.
- Hymon, Steve. "Overview of Measure M Projects and Programs." *The Source*. N.p., 10 June 2016. Web. 31 Oct. 2016.
- "Hyperloop." *Hyperloop Transportation Technologies*. N.p., n.d. Web. 25 Nov. 2016.
- "Hyperloop Transportation Technologies Press Kit." *Hyperloop Transportation Technologies*. N.p., n.d. Web. 26 Nov. 2016.
- Jacobs, Jane. *Dark Age Ahead*. New York: Random House, 2004. Print.
- Jaffe, Eric. "Be Careful How You Refer to the So-Called 'Great American Streetcar Scandal.'" *CityLab*. N.p., n.d. Web. 8 Nov. 2016.
- Jeffcote, Elisabeth. "Louis Sullivan: Influence and Innovation." *Art Journal* (2014): n. pag. Print.
- Jensen, Thor. "Diesel Engine, 1900: Great Inventions That Debuted At The World's Fair - Tested.com." *Tested*. N.p., n.d. Web. 11 Oct. 2016.
- Johnson, Matt, and 2013. "Musk's Hyperloop Math Doesn't Add up." *Greater Greater Washington*. N.p., n.d. Web. 27 Nov. 2016.
- Landphair, Ted. "We're No. 1? Not in World Expos "Ted Landphair's America." N.p., n.d. Web. 9 Oct. 2016.
- Levy, Alon. "Loopy Ideas Are Fine, If You're an Entrepreneur." *Pedestrian Observations*. N.p., 13 Aug. 2013. Web. 27 Nov. 2016.
- "London." *Bureau International des Expositions*. N.p., n.d. Web. 20 Oct. 2016.
- Kantchev, Georgi. "World Expositions Can Benefit or Haunt Host Cities." *The New York Times* 25 Aug. 2013. *NYTimes.com*. Web. 5 Nov. 2016.
- Kerouac, Jack. *On the Road*. New York: Penguin, 1991. Print.

- Korosec, Kristin. "Intel Is Making a Major Investment in Autonomous Vehicles." *Fortune*. N.p., 15 Nov. 2016. Web. 16 Nov. 2016.
- Krisher, John. "Exec: Most Lyft Rides Will Be in Autonomous Cars in 5 Years." *Bloomberg.com*. N.p., 18 Sept. 2016. Web. 24 Nov. 2016.
- "Manifest Destiny." *History.com*. N.p., 2010. Web. 30 Nov. 2016.
- Masters, Nathan. "L.A.'s First Freeways." *KCET*. N.p., 15 Aug. 2012. Web. 1 Dec. 2016.
- McDonough, William, and Michael Braungart. "The Hannover Principles." *William McDonough Architects*. 1992.
- McGoogan, Cara. "Elon Musk: Tesla's Autopilot Is Twice as Safe as Humans." *The Telegraph* 25 Apr. 2016. *www.telegraph.co.uk*. Web. 22 Nov. 2016.
- "Measure M: Metro's Plan to Transform Transportation in LA." N.p., n.d. Web. 30 Oct. 2016.
- "Measure R." *Metro*. N.p., n.d. Web. 31 Oct. 2016.
- Meisler, Marty. Telephone Interview. 20 Oct. 2016.
- Merin, Gili. "AD Classics: The Crystal Palace / Joseph Paxton." *ArchDaily*. N.p., 5 July 2013. Web. 29 Nov. 2016.
- Metcalf, John. "L.A. Mayor Eric Garcetti: We Will Be the First City to Do Autonomous Vehicles Right." *CityLab*. N.p., 29 Sept. 2014. Web. 23 Nov. 2016.
- "Monthly Report." *Google Self-Driving Car Project*. N.p., Sept. 2016. Web. 21 Nov. 2016.
- Morris, David. "Is Elon Musk's Hyperloop Fatally Flawed?" *Fortune*. N.p., 11 Sept. 2015. Web. 27 Nov. 2016.
- Michaels, Daniel. "The U.S. Can't Host a World Expo, and Fans Say That's No Fair." *Wall Street Journal* 20 Feb. 2009. *Wall Street Journal*. Web. 9 Oct. 2016.
- Mui, Chunka. "Driverless Taxis Might Replace Private Cars And Public Transit." *Forbes*. N.p., 17 Apr. 2014. Web. 23 Nov. 2016.
- Mullin, John R. *World's Fairs and Their Impact upon Urban Planning*. Monticello, IL: Council of Planning Librarians, 1972. Web. 11 Oct. 2016.
- Musk, Elon. "Hyperloop Alpha." *SpaceX*. N.p., 2013. Web. 25 Nov. 2016.
- Nelson, Laura J. "Expo Line Doesn't Have Enough Rail Cars for Its Surging Ridership." *Los*

- Angeles Times*. N.p., 5 Aug. 2016. Web. 3 Nov. 2016.
- Newsom, Gavin. Plenary and Celebration, Greenbuild International Conference and Expo, 9 Oct. 2016, Microsoft Theater, Los Angeles, CA. Speech.
- Nichols, Chris. "Does California Really Have the '6th Largest Economy on Planet Earth?'" *PolitiFact*. N.p., 26 July 2016. Web. 30 Oct. 2016.
- Novak, Matt. "Broadacre City: Frank Lloyd Wright's Unbuilt Suburban Utopia." *Paleofuture*. N.p., 16 Apr. 2014. Web. 29 Nov. 2016.
- . "Nobody Walks in L.A.: The Rise of Cars and the Monorails That Never Were." *Smithsonian*. N.p., n.d. Web. 11 Nov. 2016.
- "Our Story." *Hyperloop One*. N.p., n.d. Web. 26 Nov. 2016.
- "Overview." *Metro*. N.p., n.d. Web. 30 Oct. 2016.
- Pastor, Manuel. "Once Upon a Time, the City of Angels Was Defined by Sprawl, Cars, and Racial Conflict - Nexus." *Zócalo Public Square*. N.p., 15 Oct. 2015. Web. 6 Dec. 2016.
- Patel, Dr. Devki. "Op-Ed: Treating Climate Change in Los Angeles." Physicians for Social Responsibility Los Angeles. N.p., 27 Aug. 2015. Web. 14 Nov. 2016.
- Peter Eisenman. *The Architecture of the City*. Cambridge, MA: MIT, 1984. Print.
- Piao, Jinan et al. "Public Views towards Implementation of Automated Vehicles in Urban Areas." *Transport Research Arena*, 14 (2016). 2168–2177. Web.
- "Population Estimates." *United States Census Bureau*. N.p., 1 July 2015. Web. 1 Nov. 2016.
- "Preliminary Statement of Policy Concerning Automated Vehicles." *National Highway Traffic Safety Administration (NHTSA)*. N.p., 30 May 2013. Web. 21 Nov. 2016.
- "Proposition A." *Metro*. N.p., n.d. Web. 31 Oct. 2016.
- "Proposition C." *Metro*. N.p., n.d. Web. 11 Nov. 2016.
- "Public Transit." *Los Angeles Convention Center*. N.p., n.d. Web. 2 Nov. 2016.
- Richmond, Jonathan. "The Mythical Conception of Rail Transit in Los Angeles." *Journal of Architectural and Planning Research* (1996): 294–320. Print.

Riebeek, Holli. "Global Warming." *NASA Earth Observatory*. N.p., 3 June 2010. Web. 15 Nov. 2016.

Rodrigue, Jean-Paul, Theo Notteboom, and Jon Shaw. *The SAGE Handbook of Transport Studies*. 1st ed. SAGE Publications Ltd (2013).

"Rolling Sculpture: Art Deco Cars from the 1930s and '40s." *North Carolina Museum of Art*. N.p., n.d. Web. 30 Nov. 2016.

Rossi, Aldo, and Peter Eisenman. *Architettura Della Città*. MIT Press, 1982. Print.

"Royal Collection - Crampton's Locomotive at The Great Exhibition." N.p., n.d. Web. 21 Oct. 2016.

Rumsey, Spencer. "Robert Moses: The Last Master Builder." *Long Island News from the Long Island Press*. N.p., 30 Nov. 2013. Web. 29 Nov. 2016.

Ryde, Robert W. "World Fairs and Museums." *A Companion to Museum Studies*. N.p., 2006. 135-51. Print.

---. *World of Fairs: The Century-of-progress Expositions*. Chicago, IL: U of Chicago, 1984. Print.

Sadowski, David. "The Chicago World's Fair, by Streetcar." *The Trolley Dodger*. N.p., 6 Feb. 2015. Web. 30 Nov. 2016.

Schierbeek, Jefferson. "Los Angeles World's Fair Chief Executive Officer Position." Message to the author. 24 Oct. 2016. E-mail.

---. Telephone Interview. 2 Nov. 2016.

---. "Hyperloop." Message to the author. 25 Nov. 2016. E-mail.

Schoettle, Brandon, and Michael Sivak. "Driverless vehicles: Fewer cars, more miles." *University of Michigan Transportation Research Institute (UMTRI)*. N.p., 11 Feb. 2015. Web. 22 Nov. 2016.

"Seattle Center Monorail." *Seattle Monorail*. N.p., n.d. Web. 23 Oct. 2016.

Shankland, Stephen. "What the Heck's a Hyperloop?" *CNET*. N.p., 9 July 2016. Web. 25 Nov. 2016.

"Sources of Greenhouse Gas Emissions." Overviews and Factsheets. *US Environmental Protection Agency*. N.p., n.d. Web. 15 Nov. 2016.

- Sinclair, Angus. *Development of the Locomotive Engine: A History of the Growth of the Locomotive from Its Most Elementary Form, Showing the Gradual Steps Made Toward the Developed Engine, with Biographical Sketches of the Eminent Engineers and Inventors who Nursed it on Its Way to the Perfected Form of To-day. Many Particulars are Also Given Concerning Railroad Development*. A. Sinclair Publishing Company, 1907.
- Smith, Dakota. "LA City Council Backs Measure M Sales Tax to Raise \$120 Billion for Transit." *Los Angeles Daily News*. N.p., n.d. Web. 1 Nov. 2016.
- "Statistics for Publication." *State of California Department of Motor Vehicles*. N.p., 2015. Web. 14 Nov. 2016.
- Stella, Rick. "The Hyperloop Is Real, and We Watched the First Test in the Nevada Desert." *Digital Trends*. N.p., 14 May 2016. Web. 26 Nov. 2016.
- Stephens, Josh. "Los Angeles Metro Tackles First Mile, Last Mile Problem." *California Planning and Development Report*. N.p., 14 June 2015. Web. 3 Nov. 2016.
- Span, Guy. "Paving the Way for Buses: The Great GM Streetcar Conspiracy." N.p., 3 Apr. 2003. Web. 8 Nov. 2016.
- Spieser, Kevin et al. "Toward a Systematic Approach to the Design and Evaluation of Automated Mobility-on-Demand Systems: A Case Study in Singapore." *Frazzoli* (2014): n. pag. *dspace.mit.edu*. Web. 24 Nov. 2016.
- Swartout, Harry. "What Happened to the World's Fair?" *Time*. 29 Apr. 2014. Web. 11 Oct. 2016.
- "The Californians: Stewart Has Cancer." NBC. *Saturday Night Live*, 14 Apr. 2012. Web. 9 Oct. 2016.
- "The Great Exhibition." *The British Library*. N.p., n.d. Web. 18 Oct. 2016.
- "The Impact of the Cold War on Washington, The 1962 Seattle World's Fair." *Center for the Study of the Pacific Northwest, University of Washington*. N.p., n.d. Web. 30 Nov. 2016.
- Tinoco, Matt. "Why We Don't Take Public Transit: LAist Readers Respond." *LAist*. N.p., n.d. Web. 1 Nov. 2016.
- "Total Energy." *U.S. Energy Information Administration (EIA)*. N.p., n.d. Web. 13 Nov. 2016.
- "Total Energy Consumption." *World Energy Statistics | World Energy Consumption & Stats*. N.p., 2015. Web. 14 Nov. 2016.

Trachtenberg, Alan. *The Incorporation of America: Culture and Society in the Gilded Age*. Ed. Eric Foner. New York: Hill and Wang, 1982. Print.

“Transcontinental Railroad.” *History.com*. N.p., 2010. Web. 29 Nov. 2016.

Ulanoff, Lance. “Hyperloop One Passes First Big Test.” *Mashable*. N.p., 11 May 2016. Web. 28 Nov. 2016.

“The USA Needs the BIE. The BIE Deserves the USA.” *USA-BIE.org*. N.p., n.d. Web. 28 Sept. 2016.

Vanderbilt, Tom. “Autonomous Cars Through the Ages.” *WIRED*. N.p., 6 Feb. 2012. Web. 21 Nov. 2016.

---. “Let the Robot Drive: The Autonomous Car of the Future Is Here.” *WIRED*. N.p., 20 Jan. 2012. Web. 21 Nov. 2016.

“Vehicles, Air Pollution, and Human Health.” *Union of Concerned Scientists*. N.p., n.d. Web. 14 Nov. 2016.

Waldmeir, Patti. “Shanghai: Expo Has a Transforming Effect.” *Financial Times*. N.p., 27 Oct. 2010. Web. 27 Sept. 2016.

Walker, Jim. *Los Angeles Railway Yellow Cars*. Arcadia Publishing, 2007. Web.

“What Is an Expo?” *Bureau International des Expositions*. N.p., n.d. Web. 20 Oct. 2016.

White, John H. *A History of the American Locomotive: Its Development, 1830-1880*. Courier Corporation, 1979.

Wibberley, Ryan. “Uber Shows That The Future Is Driverless, But Why?” *Forbes*. N.p., 15 Nov. 2016. Web. 24 Nov. 2016.

“World’s Fairs.” Expo 2023 Minnesota. N.p., n.d. Web. 27 Sept. 2016.

Yeomans, Gillian. “Autonomous Vehicles Handing Over Control: Opportunities and Risk for Insurance.” 2014: n. pag. Web.

Zemeckis, Robert. *Who Framed Roger Rabbit: 25th Anniversary Edition*. Touchstone Home Entertainment, 2013. Film.

“25 Stunning Art Deco Cars.” *Complex*. N.p., 25 Aug. 2012. Web. 30 Nov. 2016.

“67 Things You’ll Never Hear an Angeleno Say.” Time Out Los Angeles. N.p., 5 Apr. 2014. Web. 9 Oct. 2016.

- “1900 Paris.” *Bureau International des Expositions*. N.p., n.d. Web. 22 Oct. 2016.
- “1933 Chicago.” *Bureau International des Expositions*. N.p., n.d. Web. 30 Nov. 2016.
- “1939 New York.” *Bureau International des Expositions*. N.p., n.d. Web. 22 Oct. 2016.
- “1941: Federal-Aid Highway Act.” *United States Senate*. N.p., n.d. Web. 13 Nov. 2016.
- “1962 Seattle.” *Bureau International des Expositions*. N.p., n.d. Web. 23 Oct. 2016.
- “2000 Hannover.” *Bureau International des Expositions*. N.p., n.d. Web. 23 Oct. 2016.
- “2009 Long Range Transportation Plan.” *Los Angeles County Metropolitan Transportation Authority*. n. pag. Web.